



DIGBY  
—  
OF BODIES

1669







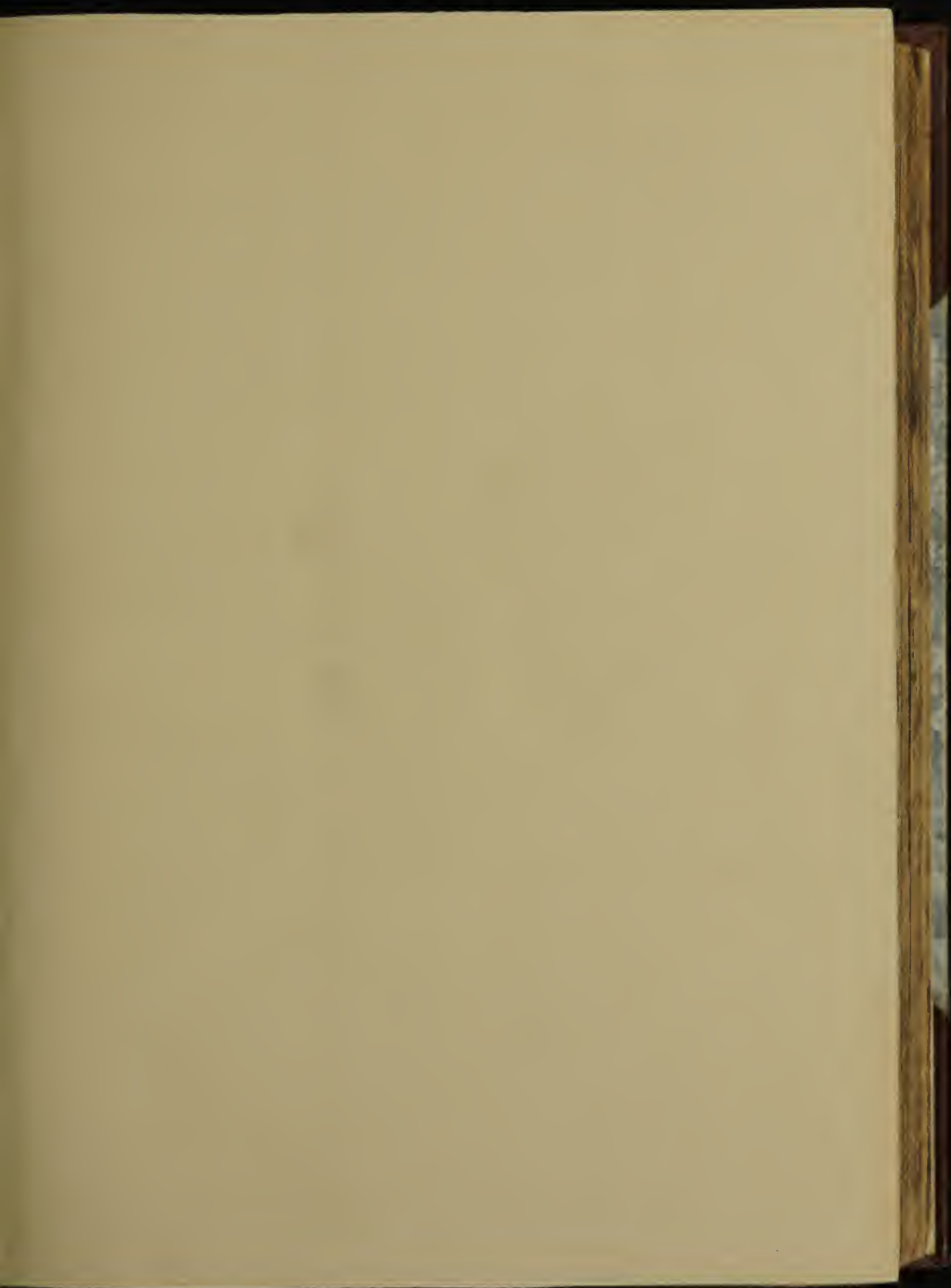


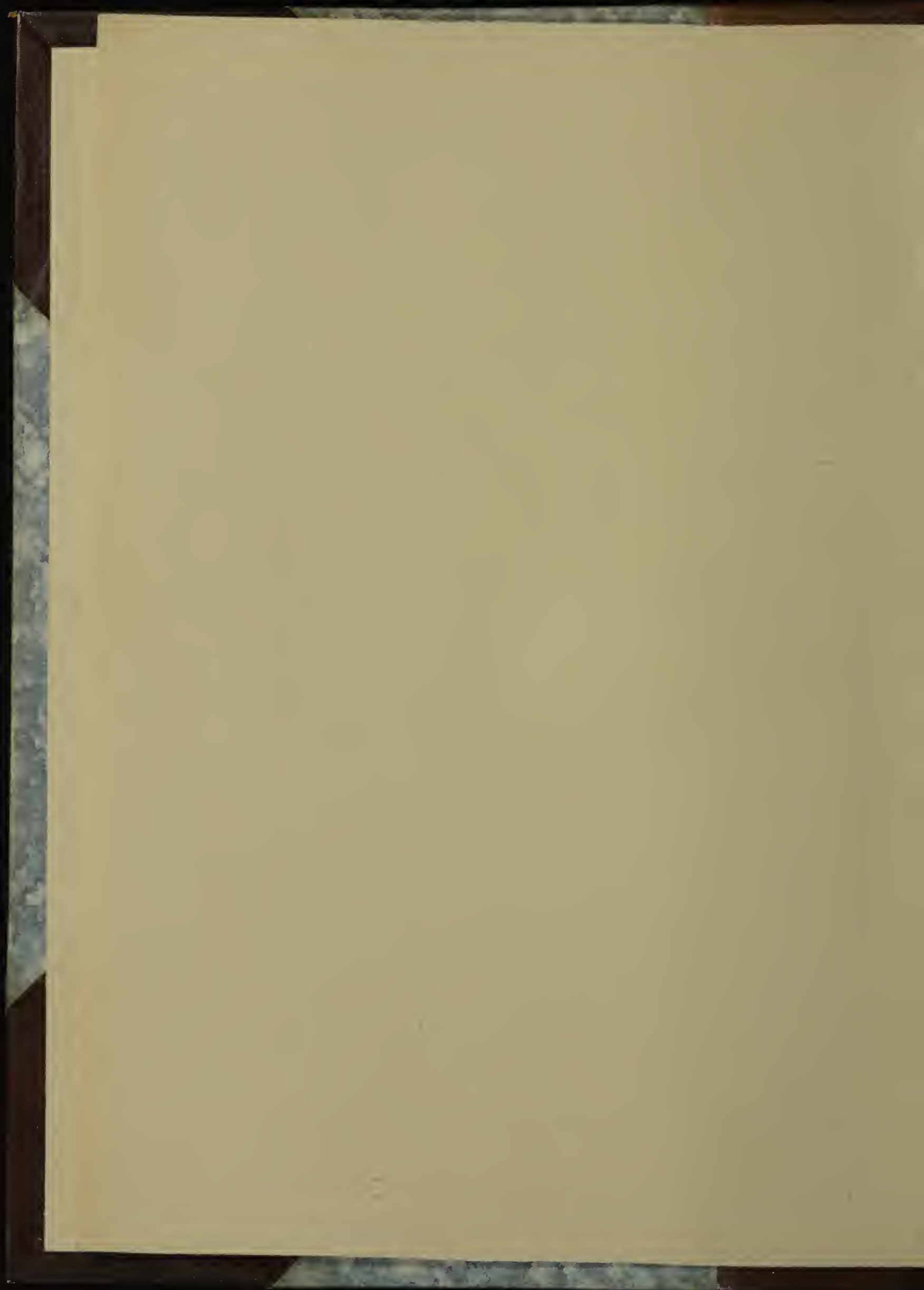




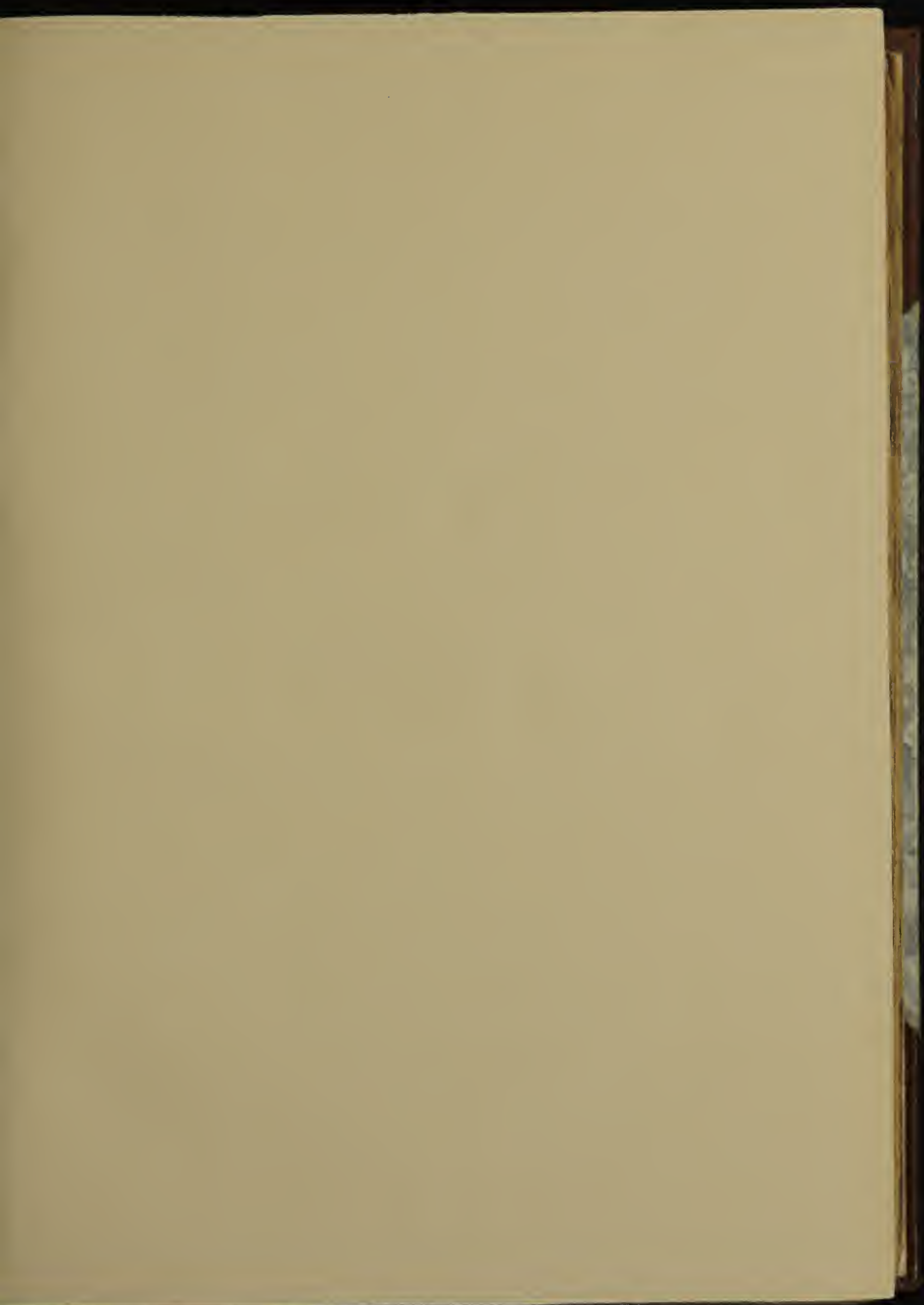
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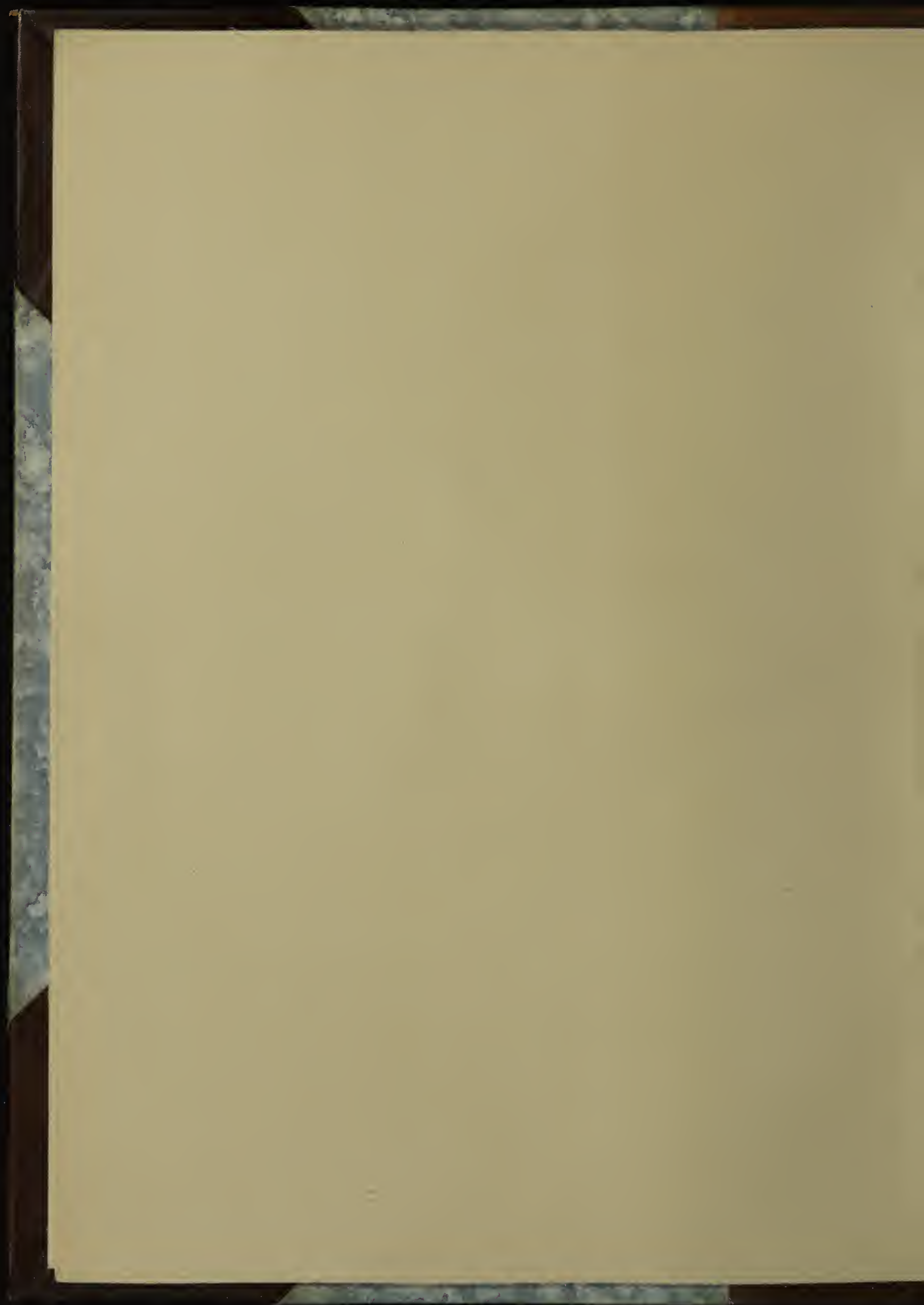














Ed. Jos Kirby. 1753

OF  
**BODIES,**  
AND OF  
Mans Soul.

TO DISCOVER THE  
**IMMORTALITY**  
OF  
**REASONABLE SOULS.**

With two Discourses  
Of the Powder of Sympathy,  
AND  
Of the Vegetation of Plants.

By Sir **KENELM DIGBY** Knight.

Ψυχῆς φύσιν ἀξίως λόγου  
Κατανοῆσαι οἷε διαπτόν εἶναι,  
Ἀνεὺ τῆς τῆ ὅλης φύσεως;

*Anima naturam, absque totius natura,  
Sufficienter cognosci posse existimas?*

Plato in Phædr.

**LONDON,**  
Printed by S.G. and B.G. for John Williams, and are to be sold in  
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T O M Y S O N

*KENELM DIGBT.*

S O N,



He calamity of this time being such, as hath bereft me of the ordinary means of expressing my affection to you; I have been casting about to find some other way of doing that, in such sort as you may receive most profit by it. Therin I soon pitched on this consideration, That Parents owe their Children, not not onely Material Subsistence for their Body, but, much more, Spiritual Contributions to their better part, their Mind. I am much bound to God, that he hath endued you with one, very capable of the best instructions: and withal, I therefore esteem my self oblig'd to do my utmost, for moulding



it to its most advantage. If my aim therein prove successful, you will with more ease digest those inconveniences and distresses, which already you have begun to be acquainted with; and that threaten daily worse to you; For, how can a man suffer his heart to be dejected at the privation of any temporal blessings; while he considers the inanity of them, and that nothing is worthy his serious thought, but what may accompanie him to his Eternal habitation? What needs he fear the desolations of War, and the worst they can do against him; who have his Estate in their power; when he may be rich with a much more nobler treasure, that none but himself can rob him of? without doubt, he that shall seriously reflect on the excellency of his own nature, and upon the admirable perfect and happy state he shall most certainlie arrive to, if he but wean himself from those worldlie impediments that here clog his soules flight; cannot choose but look, with a disdainful eye, upon the glittering trifles, that weak spirits delight themselves with. If e deem it not requisite (as of old, the famous Wise man did) to throw away those  
en-



encumbrances, to the end he may the more freely attend to divine contemplation, (for worldly goods, duly, used, may be very advantageous both to ones self and to others); yet, at least, he will not repine at Fortunes recalling what she formerly had but lent him, and permitted him the use of.

That, then, you may be arm'd against the worst may arrive to you, in this unhappy state of affairs, in our distressed Country; I send you those considerations of *the Nature and Immortality of Humane Souls*, which, of late, have been my chief entertainment. The progress you have already made in the study of Philosophy hath (I am perswaded) enabled you to benefit your self, with what I have written on this subject: on the serious examining of which, if you will employ but half the time, that I have done in spinning out my thoughts, and weaving them into the piece you see; I doubt not but you will thereby receive so much contentment, as well as profit, that you will not repent you of your pains. Besides that, *Intellectual* entertainments are the purest, and the noblest, and the most proportionate



onate to Mans Nature, and prove the most delightful to him, when they are duly relished. You will presently agree, that the matter I handle is the most important and weighty, within the whole Extent of humane nature, for a worthy person to employ himself about. The advantage that Man hath over unreasonable creatures is, that what he doth is by election : and he is himself master of all his actions ; wheras they are impelled by outward causes, to all they do. It is properly said of them, that *aguntur magis quàm agunt* : He only is free ; and in all varieties of circumstances, hath the power to choose one and reject another. Now, to have this election wisely made, and becoming a Man, requires that it be steer'd by knowledg. To do any thing well, a man must first know thoroughly all that concerns the action he is about ; and chiefly the end of it. And certainly, of all his actions, the government of himself is the most important, and nearest concerning him. The end of that government, and of all a Man's aims is by all men agreed to be *Beatitude* ; that is, his being completely well, and in a condition of enjoying the  
most



most happens that this nature is capable of. For arrival wherto, 'tis impossible to pitch upon the direct and sure means, unless it be first determin'd, whether the Beatitude we speak of belong to this life, or be not to be attain'd til we come to the next: or rather, whether or no there be another life, besides this, to be happy in. For, if there remains an Eternitie to us, after the short revolution of time we so swiftly run over here on Earth; 'tis clear, that all the happiness which can be imagin'd in this fleeting state is not valuable, in respect of the *future*; nor anything we do here is considerable, otherwise than as it conduces to the making our condition, *then* better or worse. Now, the way to be sure of this is either *Infallible Authority*, or *Evident Science*. They that rely on the first depend of others: and they only know, are absolutely complete of themselves; and have within themselves the Principles wherby to govern their Actions, in what is of highest consequence to them. 'Tis true, every body is not of a strain of Wit and Judgment to be of this Rank: and who are not, must be contented to believe others, and be



satisfied with what is taught them. But he, that will be of a superiour Orbe must make this his study. This is the adequate entertainment of a worthy person.

To conceive how high and excellent this Science of governing a Man in order to *Beatitude* in the next world is, we may consider how, among all arts that concern this life, the art of a *States-man*, to whom belongs to see a Common-wealth well govern'd, is by much the noblest. All other arts are but ministerial to him. He makes use of the Soldier, of the Lawyer, of the Orator, of the Antiquary, of the Physician, as best conduces to the end he aims at, of making the Common-wealth he governs happy and flourishing. All other meaner Trades serve him in a yet lower degree. Yet after all, he must take his measures from the *Metaphysician* or *Divine*. For, since the government of a Society of men aims at giving them the best being they are capable of; and, since Man's well-being here in this life is but *instrumentally* good, as being the means for him to be well in the next life; 'tis evident, the *States-man's* art is but instrumental to *That*,  
which



which shews how every particular man must govern his life, to be partaker of a happy Eternity : And consequently, if a Statesman has not this Science, he must be subject to a braver man, than himself, whose province is to direct all his actions to This end. We are told, how reverently great *Cæsar* listened to the discourses of learned *Achoreus*, how observant *Alexander* was of his Master *Aristotle*, how secure *Nero* trode whiles *Seneca* guided his steps, how humble *Constantine* was to *St. Sylvester's* precepts, how *Charlemain* govern'd himself in his most important actions by *Alcuine's* advice : In a word, all the *Great-men* of Antiquity, as well among the *Romans* as among the *Grecians*, had their Philosophers and Divines, in their kind, belonging to them, from whom they might derive rules of living and doing as they ought upon all occasions, if themselves were not Masters in that superiour and all-directing Science. He that sees not by his own light, must, in this dangerous Ocean, steer by the Lantern which another hangs out to him. If the person he relies on, either withholds the light from him, or shews him a false one, he is presently in the dark,



dark, and cannot fail of losing his way. How great an authority had the *Augurs* and *Priests* among the rude *Romans*, to forbid any Publick act or break any Assembly, upon pretence of Religious duties; when they liked not the business in agitation? The like may interess'd *Divines* among *Christians* do, if the *Ministers of State* have not some insight into *Divinity*. He leads a vexatious life, who, in his noblest actions, is so gored with scruples that he dares not make a step, without the authority of another to warrant him.

Yet, I do not conclude that he, whom I design by the character of a *Brave Man*, should be a professed or complete *Metaphysician* or *Divine*, and consummate in every curious circumstance that belongs to this Science; it suffices him to know it in bulk, and have so much *Divinity*, as, in common occurrents, to be able to govern himself, and, in special ones, to understand what and why his *Divine* perswades him to any thing; so that even then, though not without help, yet he governs himself, and is not *blindly* govern'd by another. He that aims at being a perfect  
Hors-



Hors-man, is bound to know in general (besides the art of Riding) the nature and temper of Horses; and to understand the different qualities of Bits, Saddles, and other utensils of a Hors-man: But, the utmost exactness in these particulars belongs to Farriers, Saddlers, Smiths, and other Tradesmen; of all which the judicious Rider knows how to make due use, when he has occasion, for his principal end, which is, orderly governing his Horse. In like manner, he, whom we design by a complete *Brave Man*, must know solidity, the main End he is in the World for: and withall, how to serve himself, when he pleases and needs, of the Divine's high Contemplations, of the Metaphysician's subtile Speculations, of the Natural-Philosopher's minute Observations, of the Mathematician's nice Demonstrations, and whatever else of particular Professions may conduce to his End; though without making any of them his profess'd business.

To lay grounds for such knowledg as this is the scope of my ensuing Discourse. My first aim was to beget it in my self: to  
which



which end the digesting my thoughts into Order, and the setting them down in Writing, was necessary; for, without such strict examination, as the penning them affords one means to make, they would hardly have avoided being disjointed and roving ones. Now, that I have done that, my next aim is, that You, to whom I wish as much good as to my self, may reap as much benefit by the Studying it, as I have done by the Composing it.

My end then being a private one, (as looking no further, than You, my Son, and my Self) I have not endeavour'd to express my Conceptions, either in the Phrase or Language of the Schools. It will serve our turn to comprehend the Substance, without confining our selves to any scrupulous exactness in what concerns only form. And, the same consideration has made me pass slightly over many particulars, in my First Treatise, *of the Nature of Bodies*; on which learned and witty men might spin out large Volumes. For, in that part I aim no further, than to shew what *may* be effected by Corporeal Agents. There, *Possibility* serves  
my



my turn, as well as the determinate indivisible point of *Truth*. I am obliged to that, only in my main great Theme, *the Soul*, in regard of which, the numerous crooked narrow cranies, and the restrained flexuous rivolets of Corporeal things, are all contemptible; further than the knowledge of them serves to the knowledge of the Soul: And a Gallant man, whose thoughts flie at the highest Game, requires no further insight into them, than to satisfie himself by wha tway they may be performed; deeming it far too mean for him, to dwell upon the subtilest of their mysteries for Science sake,

Besides this libertie that the scope I aim at allows me, of passing very cursorily over sundry particulars; I find now, at my reading all over together what I have written ( to deliver it to the Printer ) that, even in that which I ought to have done to comply with my own design and expectation, I am fallen very short: so that, if I had not unwarily too far engaged my self for the present publishing it, truly, I should have kept it by me, till I had once again gone over it. I find the whole piece very confusedly done;  
the



the stile unequal and unpolished; many particulars (when they are not absolutely necessary to my main drift ) too slightly touch'd , and far from being driven home: and, in a word, all of it seems to be rather but a loose model and roughcast of what I design to do, than a complete Work thoroughly finished.

But, since, by my overforward promising of this piece to several Friends that have been very earnest for it, I have now brought my self to that pass, that it would ill become me to delay any longer the publishing of something on this Subject; and that, obligations, of another nature, permit me not at present to dwell any longer upon *This*, ( besides that so lazy a brain, as mine is, grows soon weary when it has so intangled a skean, as this to unwind ) : I now send it you as it is; but, with a promise that, at my first leisure, I will take a strict survey of it, and then, in another Edition, will polish, correct and add what shall appear needful to me. If any man shall take the Book out of my hand, invited by the Title and Subject to look into it; I pray you in my behalf represent to him, how distant my profession is, and how contrary my Education  
has



has been to writing of Books. In every Art, the plainest that is, there is an Apprentiship necessary, before it can be expected one should work it in a fashionable piece. The first attempts are always very imperfect aimings; and scarce discernable what they are meant for, unless the Master guide his Scholars hand. Much more will the same happen in so difficult and spiny an affair, as the writing on such a nice and copious Subject as this is, to one who is so wholly ignorant of the Laws of Method as I am.

This free and ingenuous acknowledgment on my side will, I hope, prevail with all ingenuous person, who shall read what I have written, to advertise me fairly (if they judge it worth their while) of what they dislike in it: to the end that, in another more accurate Edition, I may give them better satisfaction. For, besides what failings may be in the Matter, I cannot doubt, but even in the Expressions of it, there must often be great obscurity and shortness; which I, who have my thoughts filled with the things themselves, am not aware of: So that, what peradventure may seem very full to me, because every imperfect  
touch



touch brings into my mind the entire notion and whole chain of circumstances belonging to that thing I have so often beaten upon; may appear very crude and maimed to a Stranger, that cannot guess what I should be at otherwise, than as my direct words lead him.

One thing more I shall wish you to desire of them who happily may peruse these two Treatises; as well for their own sakes, as for mine: And that is, that they will not pass their censure upon any particular piece, or broken parcel of either of them, taken by itself. Let them draw the entire Thrid through their fingers, and examine the consequentness of the *Whole Body* of the doctrine I deliver; and let them compare it, by a like survey, with what is ordinarily taught in the *Schools*: and, if they find in theirs, many bracks and short ends, which cannot be spun into an even piece, and in mine, a fair coherence througout; I shall promise my self a favourable doom from them, and that they will have an acquiescence in themselves to what I have here presented them. Whereas, if they but ravel it over loosely, and pitch upon disputing against *particular*



*lar Conclusions*, that, at the first encounter of them single, may seem harsh to them; which is the ordinary course of Flashy Wits, who cannot fadome the whole extent of a large discourse: 'tis impossible, but that they should be very much unsatisfied of me; and go away with a perswasion, that some such Truths, as, upon the whole matter, are most evident (one stone in the Arch supporting another, and the whole), are meer *Chymeras* and wild *Paradoxes*.

But ( Son ) 'tis time my Book should speak it self, rather than I speak any longer of it here. Read it carefully over, and let me see, by the effects of your Governing your self, that you make such right use of it, as I may be comforted in having chosen you to bequeath it to. God in Heaven bless you. *Paris* the last of *August*, 1644.

Your loving Father,

*KENELM DIGBY.*



# TABLE

## Of the First TREATISE

### CONCERNING

# BODIES.

#### PREFACE.

#### CHAP. I.

**A** Preamble to the whole Discourse ; Concerning Notions in general.

1. Quantity is the first, and most obvious affection of a body.
2. Words do not express things as they are in themselves, but only as they are painted in the minds of men.
3. The first error that may arise from hence; which is a multiplying of things, where no such multiplication is really found.
4. A second error: the conceiving many distinct things as really one thing.
5. Great care to be taken to avoid the errors which may arise from our manner of understanding things.
6. Two sorts of words to express our notions, the one common to all men, the other proper to scholars.
7. Great errors arise by wresting

words from their common meaning to express a more particular or studied notion.

#### CHAP. II. Of Quantity

1. We must know the vulgar and common notion of Quantity, that we may understand the nature of it.
2. Extension or divisibility is the common notion of Quantity.
3. Parts of Quantity are not actually in their whole.
4. If parts were actually in their whole, Quantity would be composed of indivisibles.
5. Quantity cannot be composed of indivisibles.
6. An objection to prove that parts are actually in Quantity; with a declaration of the mistake from whence it proceeds.
7. The solution of the former objection: and that sense cannot discern whether one part be distinguished from another, or no.
8. An



## TABLE.

8. An enumeration of the several specieses of Quantity, which confirms that the essence of it is divisibility.

### CHAP. III.

#### Of Rarity and Density.

1. What is meant by Rarity and Density.
2. It is evident that some bodies are rare and others Dense; though obscure, how they are such.
3. A brief enumeration of the several properties belonging to rare and dense bodies.
4. The Opinion of those Philosophers declared, who put rarity to consist in an actual division of a body into little parts.
5. The former opinion rejected, and the ground of their error discovered.
6. The opinion of those Philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.
7. The opinion of vacuities refuted.
8. Rarity and Density consist in the severall proportions which Quantity hath to its Substance.
9. All must admit in Physical bodies, a Metaphysical composition.

### CHAP. IV.

#### Of the four First Qualities: and of the four Elements:

1. The notions of Density and rarity have a latitude capable of infinite variety.
2. How moistness and driness are begotten in dense bodies.
3. How moistness and dryness are begotten in rare bodies.
4. Heat is a property of rare bodies, and cold of dense ones.
5. Of the two dense bodies, the less dense is more cold: but of the two rare ones, the less rare, is less hot.
6. The extreme dense body is more dry, than the extreme rare one.
7. There are but four simple bodies: and these are rightly named Elements.
8. The Author doth not determine whether every Element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.

### CHAP. V.

#### Of the operations of the Elements in general. And of their Activities compared with one another.

1. The first operation of the Elements is division, out of which  
B 2 result



## TABLE.

results local motion.

2. What place is, both notionally and really.
3. Local motion is that division, whereby a body changes its place.
4. The nature of quantity of it self is sufficient to unite a body to its place.
5. All operations amongst bodies are either local motions, or such as follow out of local motion.
6. Earth compared to Water in activity.
7. The manner whereby fire gets into fewel, proves that it exceeds earth in activity.
8. The same is proved by the manner, whereby fire comes out of fewel and works upon other bodies.

### CHAP. VI. Of Light, what it is.

1. In what sense the Authour rejects qualities.
2. In what sense the Authour admits of qualities.
3. Five arguments proposed to prove that light is not a body.
4. The two first reasons to prove Light a body, are, the resemblance it hath with fire; and because if it were a quality, it would always produce an equal to it self.

5. The third reason, because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which Light hath.

6. The fourth reason, from the manner of the generation and corruption of light, which agrees with fire.

7. The fifth reason, because such properties belong to light as agree onely to bodies.

### CHAP. VII.

Two Objections answer'd against light being fire; a more ample proof of its being such.

1. That all light is hot, and apt to heat.
2. The reason why our bodies for the most part do not feel the heat of pure light.
3. The experience of burning glasses, and of soultry gloomy weather, prove light to be fire.
4. Philosophers ought not to judge of things, by the rules of vulgar people.
5. The different names of light and fire proceed from different Notions of the same Substance.
6. The reason why many times fire and heat are deprived of light.
7. What becometh of the body of light when it dies.

8. An



## TABLE.

8. *An experiment of some, who pretend that light may be precipitated into powder.*

9. *The Authors opinion concerning Lamps, pretended to have been found in Tombs, with insusceptible lights.*

### CHAP. VIII.

*An answer to three other Objections formerly proposed, against Light being a Substance.*

1. *Light is not really in every part of the room it enlightneth, nor fills entirely any sensible part of it, though it seem to us to do so.*

2. *The least sensible point of a diaphanous body hath room sufficient to contain both air and light, together with a multitude of beams issuing from several lights, without penetrating one another.*

3. *That light doth not enlighten any room in an instant, and that the great celerity of its motion makes it imperceptible to our senses.*

4. *The reason why the motion of light is not discern'd coming towards us; and that there is some real tardity in it.*

5. *The Planets are not certainly ever in that place where they appear to be.*

6. *The reason why light, being a body, doth not by its motion shatter other bodies into pieces.*

7. *The reason why the body of light is never perceiv'd to be fan'd by the wind.*

8. *The Reasons for, and against lights being a body compared together.*

9. *A summary repetition of the reasons which prove that light is fire.*

### CHAP. IX.

*Of Local Motion in common.*

1. *No local motion can be performed without succession.*

2. *Time is the common measure of all succession.*

3. *What velocity is, and that it cannot be infinite.*

4. *No force so little, but is able to move the greatest weight imaginable.*

5. *The chief principle of Mechanics, deduced out of the former discourse.*

6. *No movable can pass from rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees which are below the obtained degree.*

7. *The conditions which help to motion, in the movable, are three; in the medium, one.*

8. *No body hath any intrinsecal virtue to move it self towards any determinate part of the Universe.*

(B 3.)

9. *The*



## TABLE.

9. The encrease of motion is always made in the proportion of the odd numbers.
20. No motion can encrease forever, or without coming to a period.
11. Certain Problems resolved, concerning the proportion of some moving Agents compared to their effects.
12. When a movable comes to rest, the motion decreases according to the Rules of encrease.

### CHAP. X.

Of Gravity and Levity; and of Local Motion commonly term'd Natural.

1. Those motions are call'd natural which have constant causes, and those violent which are contrary to them.
2. The first and most general operation of the Sun is the making and raising of atomes.
3. The light rebounding from the earth with atomes causes two streams in the air, the one ascending, the other descending; and both of them in a perpendicular line.
4. A dense body placed in the air between the ascending and descending stream, must needs descend.
5. A more particular explication

- of all the former doctrine touching gravity.
6. Gravity and Levity do not signify an intrinsecal inclination to such a motion in the bodies themselves which are term'd heavy and light.
7. The more dense a body is, the more swiftly it descends.
8. The velocity of bodies descending doth not encrease in proportion to the difference that may be between their several densities.
9. More or lesse gravity produces a swifter or a slower descending of a heavy body. Aristotles argument to disprove motion in vacuo is made good.
10. The reason why, at the inferior quarter of a circle, a body descends faster by the Arch of that quarter, than by the cord of it.

### CHAP. XI.

An answer to objections against the causes of Natural Motion, avow'd in the former Chapter; and a refutation of the contrary opinion.

1. The first objection answered; why a hollow body descends slower than a solid one.
2. The second objection answer'd and the reason shown, why atomes do continually overtake the



## TABLE.

*the descending dense body.*

3. *A curious question left undecided.*
4. *The fourth objection answer'd; why the descent of the same heavy bodies is equal in so great inequality of the atomes which cause it.*
5. *The reason why the shelter of a thick body doth not hinder the descent of that which is under it.*
6. *The reason why some bodies sink, others swim.*
7. *The fifth objection answer'd; concerning the descending of heavy bodies in streams.*
8. *The sixth objection answer'd; and that all heavy elements doe weigh in their own spheres.*
9. *The seventh objection answer'd; and the reason why we do not feel the course of the air and atomes that beat continually upon us.*
10. *How, in the same body, gravity may be greater than density, and density than gravity; though they be the same thing.*
11. *The opinion of gravities being an intrinsecal inclination of a body to the centre, refuted by reason.*
12. *The same opinion refuted by several experiences.*

## CHAP. XII.

### Of Violent Motion.

1. *The State of the question touching the cause of violent motion.*
2. *That the medium is the only cause which continues violent motion.*
3. *A further explication of the former doctrine.*
4. *That the air hath strength enough to continue violent motion in a moveable.*
5. *An answer to the first objection; that air is not apt to conserve motion; and how violent motion comes to cease.*
6. *An answer to the second objection; that the air hath no power over heavy bodies.*
7. *An answer to the third objection, that an arrow should fly faster broad wayes than long ways.*

## CHAP. XIII.

### Of three sorts of Violent motion, Reflection, Undulation, and Refraction.

1. *That reflection is a kind of violent motion.*
2. *Reflection is made at equal angles.*
3. *The causes and properties of undulation.*

4. *Re.*



## TABLE.

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| <p>4. Refraction at the entrance into the reflectent body is towards the perpendicular, at the going out, is from it; when the second superficies is parallel to the first.</p> <p>5. A refutation of Monsieur des Cartes his explication of refraction.</p> <p>6. An answer to the arguments brought in favour of Monsieur des Cartes his opinion.</p> <p>7. The true cause of refraction of light, both at its entrance, and at its going out from the reflecting body.</p> <p>8. A general rule to know the nature of reflection and refractions, in all sorts of surface.</p> <p>9. A body, of greater parts and greater pores, makes a greater refraction, than one of lesser parts and lesser pores.</p> <p>10. A confirmation of the former doctrine, out of the nature of bodies that refract light.</p> | <p>is in bodies of least size; and it is made by the force of Quantity.</p> <p>4. The second sort of conjunction, is compactedness in simple Elements, and it proceeds from density.</p> <p>5. The third conjunction is of parts of different Elements, and it proceeds from quantity and density together.</p> <p>6. The reason why liquid bodies do easily joyn together, and dry ones difficultly.</p> <p>7. That no two hard bodies can touch one another immediately.</p> <p>8. How mixed bodies are framed in general.</p> <p>9. The cause of the several degrees of solidity in mixed bodies.</p> <p>10. The Rule whereto are reduced all the several combinations of Elements, in compounding of mixed bodies.</p> <p>11. Earth and water are the basis of all permanent mixed bodies.</p> <p>12. What kind of bodies those are, where water is the basis, and earth the predominant Element over the other two.</p> <p>13. Of those bodies where, water being the basis, air is the predominant Element.</p> <p>14. What kind of bodies result, where water is the basis, and fire the predominant Element.</p> <p>15. Of those bodies where water</p> |
|--|---|

### CHAP. XIV. Of the composition, qualities, & Generation of mixed Bodies.

- |  |   |
|--|---|
| <p>1. The connexion of this chapter with the rest, and the Authors intent in it.</p> <p>2. That there is a least size of bodies; and that this least size is found in fire.</p> <p>3. The first conjunction of parts</p> | <p>15. Of those bodies where water</p> <p style="text-align: right;">is</p> |
|--|---|



## TABLE.

is in excess; it alone being both the basis and the predominant Element.

16. Of those bodies; where earth alone is the basis, and also the predominant in excess over the other three Elements.

17. Of those bodies where earth is the basis, & water is the predominant element over the other two.

18. Of those bodies where, earth being the basis, air is the predominant.

19. Of those bodies where, earth being the basis, fire is the predominant.

20. All the second qualities of mixed bodies arise from several combinations of the first qualities; and are at last resolv'd into several degrees of rarity & density.

21. That in the Planets & Stars there is a like variety of mixed bodies caused by light, as here on earth.

22. In what manner the Elements work on one another, in the composition of mixed bodies: and, in particular, fire, which is the most active.

23. A particular declaration touching the generation of Metals.

### CHAP. XV.

Of the Dissolution of Mixed Bodies.

1. Why some bodies are brittle

and others tough; or apt to withstand outward violence, the first instrument to dissolve mixed bodies.

2. How outward violence doth work on the most compacted bodies.

3. The several effects of fire, the second and chiefest instrument to dissolve all compounded bodies.

4. The reason why some bodies are not dissolved by fire.

5. The reason why fire melteth gold, but cannot consume it.

6. Why Lead is easily consumed, and calcined by fire.

7. Why, and how some bodies are divided by fire into Spirits, Waters, Oyls, Salts, and Earth. And what those parts are.

8. How water, the third instrument to dissolve bodies, dissolves calx into salt, and so into terra damnata.

9. How water, mingled with salt, becomes a most powerful Agent to dissolve other bodies.

10. How putrefaction is caused.

### CHAP. XVI.

An Explication of certain Maxims touching the operations and qualities of bodies: and whether the Elements be found pure in any part of the world.

1. What is the Sphere of activity in corporeal agents.

2. The



## TABLE.

- |  |   |
|--|---|
| <p>2. The reason why no body can work in distance.</p> <p>3. An objection answer'd, against the manner of explicating the former axiome.</p> <p>4. Of re-action: and first, in pure local motion, that each Agent must suffer in acting, and act in suffering.</p> <p>5. The former Doctrine applyed to other local motions design'd by particular names. And that Suisseths argument is of no force against this way of doctrine.</p> <p>6. Why some notions do admit of intension and remission; and others not.</p> <p>7. That, in every part of our habitable world, all the four elements are found pure in small atoms, but not in any great bulk.</p> | <p>6. That Ice is not water rarified, but condensed.</p> <p>7. How Wind, Snow, and Hail are made; and wind by rain allaid.</p> <p>8. How parts, of the same or divers bodies, are joyn'd more strongly together by condensation.</p> <p>9. Vacuities cannot be the reason, why water, impregnated to the full with one kind of salt, will notwithstanding receive more of another.</p> <p>10. The true reason of the former effect.</p> <p>11. The reason why bodies of the same nature do joyn more easily together than others.</p> |
|--|---|

### CHAP. XVII.

Of Rarefaction and Condensation, the two first motions of Particular bodies.

1. The Authours intent in this and the following chapters.
2. That bodies may be rarified, both by outward and inward heat; and how this is perform'd.
3. Of the great effects of Rarefaction.
4. The first manner of condensation by heat.
5. The second manner of condensation by cold.

### CHAP. XVIII.

Of another motion belonging to Particular bodies, called Attraction; and of certain operations term'd Magical.

1. What Attraction is, and from whence it proceeds.
2. The true sense of the Maxime, that Nature abhors from vacuities.
3. The true reason of attraction.
4. Water may be brought by the force of attraction to what height soever.
5. The doctrine touching the attraction of water in Syphons.
6. That the Syphon doth not prove water to weigh in its own orb.

7. Con-



## TABLE.

7. Concerning attraction caus'd by fire.
8. Concerning attraction made by viriure of hot bodies, amulets, &c
9. The natural reason given for divers operations, esteem'd by some to be magical.

### CHAP. XIX.

Of three other motions belonging to particular bodies, Filtration, Restitution, and Electrical attraction.

1. What is Filtration, and how it is effected.
2. What causes the water in Filtration to ascend.
3. Why the filter will not drop, unless the label hang lower than the water.
4. Of the motion of Restitution; and why some bodies stand bent, others not.
5. Why some bodies return only in part to their natural figure; others entirely.
6. Concerning the nature of those bodies which shrink [and stretch.
7. How great and wonderful effects proceed from small, plain, and simple principles.
8. Concerning Electrical attraction and the causes of it.
9. Cabeus his opinion refuted, concerning the cause of Electrical motions.

### CHAP. XX.

Of the Loadstones generation, and its particulas motions.

1. The extreme heat of the Sun under the Zodiack, draws a stream of air from each Pole, into the torrid Zone.
2. The atomes of these two streams coming together, are apt to incorporate with one another.
3. By the meeting and mingling together of these streams at the Equator, divers Rivolets of Atomes of each Pole are continued from one Pole to the other.
4. Of these Atomes, incorporated with some fit matter in the bowels of the earth, is made a stone.
5. This stone works by emanations, joyn'd with agreeing streams that meet them in the air; and, in fine, it is a Loadstone.
6. A Method for making experiences upon any subject.
7. The Loadstones generation, by Atomes flowing from both Poles, is confirmed by experiments observed in the stone it self.
8. Experiments to prove that the Loadstone works, by emanations meeting with agreeing streams.

(B 4)

CHAP.



## TABLE.

### CHAP. XXI.

Positions drawn out of the former doctrine, and confirm'd by experimental proofs.

1. The operations of the Loadstone are wrought by bodies, and not by qualities.
2. Objections against the former position answer'd.
3. The Loadstone is imbued with his vertue from another body.
4. The vertue of the loadstone is a double, and not one simple, vertue.
5. The vertue of the Loadstone works more strongly in the Poles of it, than in any other part.
6. The loadstone sends forth its emanations spherically. Which are of two kinds; and each kind is strongest in that hemisphere, through whose polary parts they issue out.
7. Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.
8. Concerning the declination, and other respects of a needle, towards the loadstone it touches.
9. The vertue of the loadstone goes from end to end in lines almost parallel to the axis.
10. The vertue of a loadstone is not perfectly spherical, though the stone be such.

11. The intention of nature, in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies.

12. The main Globe of the earth not a loadstone.

13. The loadstone is generated, in all parts or climates of the earth.

14. The conformity betwixt the two motions of magnetick things, and of heavy things.

### CHAP. XXII.

A solution of certain Problems concerning the Loadstone; and a short summ of the whole doctrine touching it.

1. Which is the North, and which the South Pole of a loadstone.

2. Whether any bodies besides magnetick ones be attractive.

3. Whether an iron placed perpendicularly towards the earth, doth get a magnetical vertue of pointing, towards the North, or towards the South, in that end that lies downwards.

4. Why loadstones affect iron better than one another.

5. Gilbert's reason refuted, touching a capped loadstone that takes up more iron, than one not capped and an iron impregnated, that in some case draws more strongly than the stone it self.

6. Galileus his opinion touching the



## TABLE.

*the former effects refuted.*

7. *The Authours solution to the former questions.*

8. *The reason why, in the former case, a lesser Load stone draws the interjacent iron from the greater.*

9. *Why the variation of a touched needle from the North, is greater the nearer you go to the Pole.*

10. *Whether, in the same part of the world, a touched needle may at one time vary more from the North, and at another time lesse.*

11. *The whole doctrine of the load stone summ'd up in short.*

### CHAP. XXIII.

A description of two sorts of Living creatures; Plants and Animals: and how they are framed in common to perform vital motion.

1. *The connexion of the following Chapters with the precedent.*

2. *Concerning several compositions of mix'd bodies.*

3. *Two sorts of living creatures.*

4. *An engine to express the first sort of living creatures.*

5. *An other engine by which may be express'd the second sort of living creatures.*

6. *The two former engines, and some other comparisons applied express the two several sorts of living creatures.*

7. *How plants are fram'd.*

8. *How Sensitive creatures are form'd.*

### CHAP. XXIV.

A more particular survey of the generation of Animals; in which is discover'd what part of the animal is first generated.

1. *The opinion that the seed contains formally every part of the parent.*

2. *The former opinion rejected.*

3. *The Authours opinion of this question.*

4. *Their opinion refuted, who hold that every thing contains formally all things.*

5. *The Authours opinion concerning the generation of Animals declared and confirm'd.*

6. *That one substance is chang'd into another.*

7. *Concerning the hatching of Chickens, and the generation of other animals.*

8. *From whence it happens that the deficiencies or excrescences of the parents body are often seen in their children.*

9. *The difference between the Authours opinion and the former.*

10. *That the heart is imbued with the general specifick virtues of the whole body; whereby is confirm'd the doctrine of the two former paragraphs.*

11. *That*



## TABLE.

**11.** *That the heart is the first part generated in a living creature.*

### CHAP. XXV.

**How a Plant or Animal comes to that Figure it hath.**

**1.** *That the Figure of an Animal is produced by ordinary second causes, as well as any other corporeal effect.*

**2.** *That the several figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidental causes.*

**3.** *The former doctrine is confirmed by several instances.*

**4.** *The same doctrine apply'd to Plants.*

**5.** *The same doctrine declared in leafs of trees.*

**6.** *The same apply'd to the bodies of Animals.*

**7.** *In what sense the Author admits of Vis formatrix.*

### CHAP. XXVI.

**How motion begins in Living creatures: And of the Motion of the Heart, Circulation of the Blood, Nutrition, Augmentation, and corruption or death.**

**1.** *From whence proceeds the primary motion and growth in Plants.*

**2.** *Monsieur des Cartes his opi-*

*nion touching the motion of the heart.*

**3.** *The former opinion rejected.*

**4.** *The Authors opinion concerning the motion of the heart.*

**5.** *The motion of the heart depends originally of its fibers irrigated by blood.*

**6.** *An objection answer'd against the former doctrine.*

**7.** *The circulation of the blood and other effects that follow the motion of the heart.*

**8.** *Of Nutrition,*

**9.** *Of Augmentation.*

**10.** *Of death and sickness.*

### CHAP. XXVII.

**Of the motions of Sense and of the Sensible Qualities in general; & in particular of those which belong to Touch, Taste, and Smelling.**

**1.** *The connexion of the subsequent Chapters with the precedent.*

**2.** *Of the senses and sensible qualities in general: And of the end for which they serve.*

**3.** *Of the sense of touching: and that both it and its qualities are bodies.*

**4.** *Of the taste and its qualities; that they are bodies.*

**5.** *That the smell and its qualities are real bodies.*

**6.** *Of the conformity betwixt the two senses of smelling and tasting.*

**7.** *The*



## TABLE.

7. *The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderful history of a man who could wind sent as well as any beast.*

### CHAP. XXVIII.

Of the sense of Hearing, and of the sensible quality, Sound.

1. *Of the sense of hearing: and that sound is purely motion.*
2. *Of divers arts belonging to the sense of hearing: all which confirm that sound is nothing but motion.*
3. *The same is confirmed by the effects caused by great noises.*
4. *That solid bodies may convey the motion of the air, or sound, to the Organe of hearing.*
5. *Where the motion is interrupted, there is no sound.*
6. *That not only the motion of the air, but all other motions coming to our ears, make sound.*
7. *How one sense may supply the want of another.*
8. *Of one who could discern sounds of words with his eyes.*
9. *Divers reasons to prove sound to be nothing else but a motion of some real body.*

### CHAP. XXIX.

Of Sight and Colours.

1. *That colours are nothing but*

*light mingled with darkness; or the disposition of a bodies superficies apt to reflect light so mingled.*

2. *Concerning the disposition of those bodies which produce white or black colours.*
3. *The former doctrine confirmed by Aristotles authority, reason, and experience.*
4. *How the diversity of colours do follow out of various degrees of rarity and density.*
5. *Why some bodies are diaphanous, others opacous.*
6. *The former doctrine of colours confirmed by the generation of white and black in bodies.*

### CHAP. XXX.

Of luminous or apparent Colours.

1. *Apparitions of colours through a prism or triangular glass are of two sorts.*
2. *The several parts of the object make several angles at their entrance into the prism.*
3. *The reason why sometimes the same object appears through the prism in two places; and in one place more lively, in the other place more dim.*
4. *The reason of the various colours that appear in looking thorough a prism.*
5. *The reason why the prism, in one position, may make the colours appear quite contrary to what*



## TABLE.

- |   |  |
|---|--|
| <p>what they did, when it was in another position.</p> <p>6. The reason of the various colours in general, by pure light passing through a prism.</p> <p>7. Upon what side every colour appears that is made by pure light passing through a prism.</p> | <p>2. The Authours opinion touching sensation.</p> <p>3. Reasons to perswade the Authours opinion.</p> <p>4. That vital spirits are the immediate instruments of sensation by conveying sensible qualities to the brain.</p> <p>5. How sound is convey'd to the brain by vital spirits.</p> <p>6. How colours are convey'd to the brain by vital spirits.</p> <p>7. Reasons against Monsieur des Cartes his opinion.</p> <p>8. That the symptomes of the palsy do no way confirm Monsieur des Cartes his opinion.</p> <p>9. That Monsieur des Cartes his opinion cannot give a good account, how things are conserv'd in the memory.</p> |
|---|--|

### CHAP. XXXI.

The causes of certain appearances in luminous Colours; with a conclusion of the discourse touching the Senses and the Sensible Qualities.

1. The reason of each several colour in particular, caused by light passing through a prism.
2. A difficult problem resolved touching the Prism.
3. Of the rainbow, and how, by the colour of any body, we may know the composition of the body it self.
4. That all the sensible qualities are real bodies, resulting out of several mixtures of rarity and density.
5. Why the senses are onely five in number: with a conclusion of all the former doctrine concerning them.

### CHAP. XXXII.

Of Sensation, or the motion wherby sense is properly exercised.

1. Monsieur des Cartes his opinion touching sensation.

### CHAP. XXXIII.

Of Memory.

1. How things are conserv'd in the memory.
2. How things conserv'd in the memory are brought back into the phantasie.
3. A confirmation of the former doctrine.
4. How things renew'd in the phantasie return, with the same circumstances that they had at first.
5. How the memory of things past is lost, or confounded; and how it is repaired again.

CHAP.



## TABLE.

### CHAP. XXXIV.

Of Voluntary motion, Natural faculties, and Passions.

1. Of what matter the brain is composed.
2. What is voluntary motion.
3. What those powers are which are called natural faculties.
4. How the attractive and secretive faculties work.
5. Concerning the concoctive faculty.
6. Concerning the retentive and expulsive faculties.
7. Concerning expulsion made by Physick.
8. How the brain is moved to work voluntary motion.
9. Why pleasing objects do dilate the spirits, and displeasing ones contract them.
10. Concerning the five senses, for what use and end they are.

### CHAP. XXXV.

Of the material instrument of Knowledge and Passion; of the several effects of passion; of pain and pleasure; and how the vital spirits are sent from the brain into the intended parts of the body, without mistaking their way.

1. That Septum Lucidum is the seat of the phansie.
2. What causes us to remember,

not only the object it self, but also that we have thought of it before.

3. How the motions of the phantasie are derived to the heart.
4. Of pain and pleasure.
5. Of Passion.
6. Of several pulses caused by passions.
7. Of several other effects caused naturally in the body by passions.
8. Of the Diaphragma.
9. Concerning pain and pleasure caused by the memory of things past.
10. How so small bodies as atomes are, can cause so great motions in the heart.
11. How the vital spirits sent from the brain do run to the intended part of the body without mistake.
12. How men are blinded by passion.

### CHAP. XXXVI.

Of some actions of Beasts that seem to be formal acts of reason; as doubting, resolving, inventing.

1. The order and connexion of the subsequent Chapters.
2. From whence proceeds the doubting of beasts.
3. Concerning the invention of Foxes and other beasts.
4. Of Foxes that catch Hens by lying under their roost, and by gazing upon them.

(C)

5. From



## TABLE.

- |  |  |
|--|--|
| <p>5. <i>From whence proceeds the foxes intention to rid himself of fleas.</i></p> <p>6. <i>An explication of two other inventions of Foxes.</i></p> <p>7. <i>Concerning Montagu's argument, to prove that Dogs make Syllogismes.</i></p> <p>8. <i>A declaration how some tricks are performed by Foxes, which which seem to argue discourse.</i></p> <p>9. <i>Of the Jaccatray's invention in calling Beasts to himself.</i></p> <p>10. <i>Of the Jaccals design in serving the Lion.</i></p> <p>11. <i>Of several inventions of fishes.</i></p> <p>12. <i>A discovery of divers things done by Hares, which seem to argue discourse.</i></p> <p>13. <i>Of a Fox reported to have weighed a Goose, before he would venture with it over a River; and of Fabulous stories in common.</i></p> <p>14. <i>Of the several cryings, and tones of beasts: with a refutation of those Authors who maintain them to have compleat languages.</i></p> | <p>2. <i>Of the Baboon that played on a Guittar.</i></p> <p>3. <i>Of the teaching of Elephants, &amp; other beasts to do divers tricks.</i></p> <p>4. <i>Of the orderly train of actions performed by beasts in breeding their young ones.</i></p> |
|--|--|

### CHAP. XXXVIII.

Of Prescience of future events, Providences, the knowing of things never seen before; and such other actions, observed in some living Creatures, which seem to be even above the reason that is in man himself.

- |  |  |
|--|--|
| <p>1. <i>Why Beasts are afraid of men.</i></p> <p>2. <i>How some qualities, caused at first by change in beasts, may pass by generation to the whole off-spring.</i></p> <p>3. <i>How the Parents phantasie oftentimes works strange effects in their issue.</i></p> <p>4. <i>Of Antipathies.</i></p> <p>5. <i>Of Sympathies.</i></p> <p>6. <i>That the Antipathy of beasts towards one another, may be taken away by assuefaction.</i></p> <p>7. <i>Of longing marks seen in children.</i></p> <p>8. <i>Why divers men hate some certain meats, &amp; particularly Cheese.</i></p> <p>9. <i>Concerning the providence of Ants in laying up in store for winter.</i></p> <p>10. <i>Concerning the foreknowing of beasts.</i></p> | <p>The Conclusion of the first Treatise.</p> |
|--|--|

### CHAP. XXXVII.

Of the Docility of some irrational Animals; and of certain continue actions of a long tract of time, so orderly performed by them, that they seem to argue knowledge in them.

1. *How Hawks and other creatures are taught to do what they are brought up to.*



СМЕРТЬ



# T A B L E

## Of the Second *TREATISE*

### CONCERNING

# Mans Soul.

#### PREFACE.

#### CHAP. I.

**O**F simple Apprehensions.

1. *what is a right apprehension of a thing.*
2. *The very thing it self is truly in his understanding, who rightly apprehends it.*
3. *The apprehensions of things, coming to us by our senses, are resolvable into other more simple apprehensions.*
4. *The apprehension of a Being is the most simple, and Basis of all the rest.*
5. *The apprehension of a thing is in next degree to that of Being, and it is the Basis of all the subsequent ones.*
6. *The apprehension of things known to us by our senses, consists in certain respects betwixt two things.*
7. *Respect or relation hath not really any formal being, but only in the apprehension of man.*
8. *That Existence or Being is the proper affection of man; and that*

*mans soul is a comparing power.*

9. *A thing by coming into the understanding of man loses nothing of its own peculiar nature.*

10. *A multitude of things may be united in mans understanding, without being mingled or confounded together.*

11. *Of abstracted and concrete terms.*

12. *Of universal notions.*

13. *Of apprehending a multitude under one notion.*

14. *The power of the understanding reaches as far as the extent of Being.*

#### CHAP. II.

*Of thinking and knowing.*

1. *How a judgment is made by the understanding.*

2. *That two or more apprehensions are identified in the soul, by uniting them in the stock of being.*

3. *How the notions of a substantive & an adjective are united in the soul by the common stock of being.*

4. *That a settled judgment becomes a part of our soul.*

5. *How the soul comes to deem, or settle a judgment.*

6. *How*



## TABLE.

6. How opinion is begotten in the understanding.

7. How faith is begotten in the understanding.

8. Why truth is the perfection of a reasonable Soul: and why it is not found in simple apprehensions, as well as in Enuntiations.

9. What is a solid judgment, and what a slight one.

10. What is an acute judgment, and what a dull one.

11. In what consists quickness, and clearness of judgment; and their opposite vices.

### CHAP. III.

#### Of Discourſing.

1. How diſcourſe is made.

2. Of the figures and moods of ſyllogiſms.

3. That the life of man as man conſiſts in diſcourſe; and of the vaſt extent of it.

4. Of humane actions; and of thoſe that concern our ſelves.

5. Of humane actions, as they concern our neighbours.

6. Of Logick.

7. Of Grammar.

8. Of Rhetorick.

9. Of Poetry.

10. Of the power of ſpeaking.

11. Of arts that concern dumb and inſenſible creatures.

12. Of Arithmetick.

13. Of Prudence.

14. Obſervations upon what has

been ſaid in this Chapter.

### CHAP. IV.

How a Man proceeds to Action.

1. That humane actions proceed from two ſeveral principles, underſtanding and ſenſe.

2. How our general and inbred maxims concur to Humane Actions.

3. That the rules and maxims of arts work poſitively in us, though we think not of them.

4. How the underſtanding caſts about, when it wants ſufficient grounds for action.

5. How reaſon rules over ſenſe and paſſion.

6. How we recall our thoughts from diſtractions.

7. How reaſon is ſometimes overcome by ſenſe and paſſion.

### CHAP. V.

Containing proofs out of our Single apprehenſions, that our Soul is Incorporeal.

1. The connexion of the ſubſequent Chapters with the precedent.

2. The exiſtence of corporeal things in the ſoul, by the power of apprehenſion, proves her to be immaterial.

3. The notion of Being, which is innate in the Soul, proves the ſame.

4. The ſame is proved by the notion of reſpects.



## TABLE.

5. That corporeal things are spiritualized in the understanding, by means of the soul's working in and by respects.
6. That the abstracting of Notions from all particular and individual accidents proves the immateriality of the soul.
7. That the universality of abstracted notions proves the same.
8. That collective apprehensions proves the same.
9. The operations of the soul drawing always from multitude to unity, prove the same.
10. The difference betwixt the notion of a thing in our understanding, and the impression that corresponds to the same thing in our phansie, proves the same.
11. The apprehension of negations and privations proves the same.

### CHAP. VI.

Containing proofs out of our souls operations, in knowing or deeming any thing, that she is of a spiritual nature.

1. The manner of judging or deeming, by apprehending two things to be identified, proves the soul to be immaterial.
2. The same is proved by the manner of apprehending opposition in a negative judgment.
3. That things in themselves op-

posite to one another, having no opposition in the soul, proves the same.

4. That the first truths are identified to the soul.
5. That the soul hath an infinite capacity, and consequently is immaterial.
6. That the opposition of contradictory propositions in the soul, proves her immateriality.
7. How propositions of eternal truth, prove the immateriality of the soul.

### CHAP. VII.

That our Discourfing proves our Soul to be incorporeal.

1. That in discoursing, the soul contains more in it at the same time, than is in the phantasy; which proves her to be immaterial.
2. That the nature of discourse proves the soul to be order'd to infinite knowledge; and consequently immaterial.
3. That the most natural objects of the soul are immaterial, and consequently the soul her self is such.

### CHAP. VIII.

Containing proofs out of our manner of proceeding to action, that our Soul is incorporeal.

1. That the souls being a power to order things, proves her to be immaterial.
2. That



## TABLE.

2. That the Souls being able to move without being moved, proves her to be immaterial.

3. That the souls proceeding to action with an universality and indifferency, proves the same.

4. That the quiet proceeding of reason proves the same.

5. A conclusion of what hath been said hitherto in this second Treatise.

### CHAP. IX.

That our soul is a Substance, and Immortal.

1. That Mans soul is a substance.

2. That man is compounded of some other substance, besides his body.

3. That the Soul subsists of it self, independently of the body.

4. Two other arguments to prove the same; one positive, the other negative.

5. The same is proved, because the soul cannot be obnoxious to the cause of mortality.

6. The same is proved because the Soul hath no contrary.

7. The same is proved from the end for which the Soul was created.

8. The same is proved, because she can move without being moved.

9. The same is proved from her manner of operation, which is grounded in being.

10. Lastly, it is proved from the science of Morality; the principles wherof would be destroyed, if the soul were mortal.

### CHAP. X.

Declaring what the Soul of a man, separated from his body, is, and of her knowledg and manner of working.

1. That the Soul is one simple knowing act, which is a pure substance, and nothing but substance.

2. That a separated Soul is in no place, and yet is not absent from any place.

3. That a separated Soul is not in time, nor subject to it.

4. That the Soul is an active substance, and all in it is activity.

5. A description of the Soul.

6. That a separated Soul knows all that which she knew, whilst she was in her body.

7. That the least knowledge which the Soul acquires in her body, of any one thing, causes in her, when she is separated from her body, a complete knowledge of all things whatever.

8. An answer to the objections of some Peripateticks, who main-



## TABLE.

- |   |   |
|---|---|
| <p>tain the Soul to perish with the body.</p> <p>9. The former Peripateticks refuted out of Aristotle.</p> <p>10. The operations of a separated soul compared to her operations in her body.</p> <p>11. That a separated soul is in a state of pure being, and consequently immortal.</p> | <p>5. The state of a vitious soul in the next life.</p> <p>6. The fundamenatl reason why as well happiness as misery is so excessive in the next life.</p> <p>7. The reason why mans soul requires to be in a body, and to live for some space of time joyn'd with it.</p> <p>8. That the misery of the soul in the next world proceeds out of the inequality, and not out of the falsity of her judgments.</p> |
|---|---|

### CHAP. XI.

Shewing what effects the divers manners of living in this world do cause in a soul, after she is separated from her body.

1. That a Soul in this life is subject to mutation, and may be perfected in knowledge.
2. That the knowledge which a soul gets in this life, will make her knowledge in the next life more perfect and firm.
3. That the soul of men addicted to science, whilest they lived here, are more perfect in the next world, than the souls of unlearned men.
4. That those souls which embrace virtue in this world, will be most perfect in the next; and those which imbrace vice, most miserable.

### CHAP. XII.

Of the perseverance of a soul, in the state she finds her self in, at her first separation from her body.

1. The explication and proof of that maxime, that, If the cause be in act, the effect must also be.
2. The effects of all such agents as work instantaneously are complete in the first instant that the agents are put.
3. All pure spirits work instantaneously.
4. That a soul separated from her body cannot suffer any change, after the first instant of her separation.
5. That temporal sins are justly punished with eternal pains.

The Conclusion.



Nathaniel Warner

Warner 1730





## Preface.

**T**His Writing was design'd to have seen the light under the name of One Treatise. But after it was drawn in Paper, as I cast a view over it, I found the Proæmial part ( which Treats of Bodies ) so ample in respect of the other ( which was the End of it, and for whose sake I medled with it ) that I readily apprehended my Reader would think I had gone much astray from my Text, when, proposing to speak of the Immortality of Mans Soul, three parts of four of the whole Discourse should not, so much as in one word, mention that Soul, whose nature and proprieties, I aim'd at the discovery of. To avoid this incongruity, occasioned me to change the Name and Unity of the Work; and to make the survey of Bodies, a body by it self; though subordinate to the Treatise of the Soul: Which, notwithstanding it be less in bulk, than the other, yet I dare promise my Reader, that if he bestow the pains requisite to perfect himself in it, he will find as much time well spent in the due reading of it, as in the reading of the former Treatise, though far more large.

But, I discern an Objection obvious to be made, or rather a Question; Why I should spend so much time in the consideration of Bodies, whereas none, that has formerly written of this Subject, has in any measure done the like?

I might answer, that they had, on other occasions, first written of the nature of Bodies: as I may instance in Aristotle:



## P R E F A C E.

Aristotle; and sundry others, who either have themselves professedly treated the Science of Bodies, or have supposed that part sufficiently perform'd by other pens. But truly, I was by an unavoidable necessity hereto obliged; which is, a current of doctrine that, at this day, much reigns in the Christian Schools, where Bodies and their operations are explicated after the manner of spiritual things. For we, having very slender knowledge of Spiritual Substances, can reach no further into their nature, than to know that they have certain Powers or Qualities; but can seldom penetrate so deep, as to descend to the particulars of such Qualities or Powers. Now, our Modern Philosophers have introduced such a course of learning into the Schools, that, to all questions concerning the proper natures of Bodies and their operations, 'tis held sufficient to answer, they have a Quality or a Power to do such a thing: And afterwards they dispute, whether this Quality or Power be an Entity distinct from its subject, or no, and how it is separable or inseparable from it, and the like. Conformable to this, who will look into the Books, which are in vogue in these Schools, shall find such Answers, and such controversies every where, and few others. As, of the Sensible Qualities: ask what it is to be white or red, what to be sweet or sour, what to be odoriferous or stinking, what to be cold or hot? And you are presently paid with, that it is a Sensible Quality, which has the power to make a Wall, white or red, to make a Meat agreeable or disagreeable to the taste, to make a grateful, or ungrateful Smell to the nose, &c. Likewise they make the same Questions and Resolutions, of Gravity and Levity: as, whether they be qualities, that is, Entities distinct from their subjects; and whether they be active or passive: which when they have disputed slightly, and in common, with Logical arguments, they rest there, without any further searching into the Physical causes or effects of them. The like you shall find  
of



## PREFACE.

of all strange Effects of them. The Loadstone and Electrical bodies are produced for miraculous, and not understandable things; and which must be acknowledg'd to work by hidden Qualities, that mans wit cannot reach to. And, ascending to Living Bodies, they give it for a Maxim; that Life is the action of the same Entity upon it self; that Sense is likewise a work of an intrinsecal power in the part we call Sense, upon it self: Which our predecessors held the greatest absurdities that could be spoken in Philosophy. Even some Physicians, that take upon them to teach the curing of our Bodies, often pay us with such terms among them: you have long discourses of a retentive, of an expulsive, of a purging, of a consolidating Faculty; and so of every thing that either passes in our body, or is apply'd for remedy. And the meaner sort of Physicians know no more, but that such faculties are, though indeed they that are truly Physicians know also in what they consist; without which knowledg it is much to be fear'd Physicians will do more harm than good.

But, to return to our subject: This course of doctrine in the Schools hath forced me to a great deal of pains, in seeking to discover the nature of all such actions (or of the main part of them) as were famed for incomprehensible. For, what hope could I have, out of the Actions of the Soul to convince the nature of it to be incorporeal; If I could give no other account of Bodies Operations, than that they were perform'd by qualities occult, specifical, or incomprehensible? Would not my Adversary presently answer, that any operation out of which I should press the Souls being spiritual, was perform'd by a corporeal occult quality? and that, as he must acknowledg it to be incomprehensible, so must I likewise acknowledg other qualities of Bodies to be as incomprehensible: and therefore could not with reason press him, to shew how a Body was able to do such an operation, as I should infer-



## P R E F A C E.

*fer must of necessity proceed from a spirit ; since that neither could I give account how the Loadstone drew Iron , or locked to the North, how a stone and other heavy things were carried downwards, how sight or fantasie was made, how Digestion or purging were effected, and many other such questions which are so slightly resolv'd in the Schools ?*

*Besides this Reason, the very desire of knowledge in my self, and a willingness to be available to others (at the least so far as to set them on seeking for it, without having a prejudice of impossibility to attain it ) was to me a sufficient motive, to enlarge my discourse to the Bulk it is risen to. For, what a misery is it , that the Flower and best Wits of Christendom (which flock to the Universities under pretence, and upon hope of gaining knowledge ) should be there deluded ; and, after many years of toyl and expence, be sent home again, with nothing acquired, more than a faculty and readiness to talk, like Parrats of many things ; but not to understand so much as any one, and withal with a perswasion that in truth nothing can be known ? For, setting knowledge aside, what can it avail a man to be able to talk of any thing ? What are those wranglings, where the discovery of Truth is neither sought nor hoped for, but meerly Vanity and Ostentation ? Doth not all tend, to make one seem and appear that which indeed he is not ? Nor let any body take it ill at my hands, that I speak thus of the Modern Schools: for indeed it is rather themselves, than I that say it. Excepting Mathematicks, let all the other Schools pronounce their own minds; and say ingenuosly, whether they themselves believe they have so much as any one Demonstration, from the beginning to the end of the whole course of their Learning : And if all, or the most part, will agree that any one position is demonstrated perfectly, and as it ought to be, and as thousands of conclusions are demonstrated in Mathematicks ; I*



## PREFACE.

am ready to undergo the blame of having calumniated them, and will as readily make them amends. But, if they neither will, nor can; then their own Verdict clears me: and it is not so much I, as they, that make this profession of the shallowness of their Doctrine. And to this purpose I have often heard the Lamentations of divers, as great wits as any that converse in the Schools, complaining of this defect. But, in so great an evidence of the effect, proofs are superfluous.

Wherefore, I will leave this Subject, to declare what I have here design'd, and gone about towards the Remedy of this inconvenience. Which is, that, whereas in the Schools there is a loose method, (or rather none; but) that it is lawful, by the liberty of a Commentator, to handle any Question in any place (which is the cause of the slightness of their doctrine, and can never be the way to any Science or Certitude); I have taken my beginnings from the commonest things that are in Nature. Namely from the Notions of Quantity, and its first Differences, which are the most simple and radical Notions that are, and in which all the rest are to be grounded. From them I endeavour, by immediate composition of them, and derivation from them, to bring down my discourse to the Elements, which are the primary and most simple bodies in nature: From these I proceed to Compounded Bodies, first, to those that are call'd Mixed, and then to living bodies; declaring in common the Proprieties and operations that belong to them. And by occasion, as I pass along, I light here and there on those operations which seem most admirable in nature, to shew how they are, or at least, may be performed; that, though I miss in particular of the industry of Nature, yet I may nevertheless hit my intent which is, to trace out a way, how these, and such like Operations may be effected, by an Exact disposition and ordering (though intricate) of Quantitative and Corporeal parts; and to shew, that  
they



## PREFACE.

they oblige us not to recur to hidden and unexplicable qualities. And, if I have declared so many of these, as may beget a probable perswasion in my Reader, that the rest, which I have not touched, may likewise be display'd and shew'd to spring out of the same grounds; if curious and constant searchers into Nature will make it their task to penetrate into them; I have therein obtain'd my desire and intent. Which is only, to shew from what principles all kinds of corporeal operations proceed; and what kind of operations all these must be, which may issue out of these principles: to the end, that I may from thence make a step to raise my discourse to the contemplation of the Soul, and shew, that her Operations are such as cannot proceed from those principles; which, being adequate and common to all Bodies, we may rest assured, that what cannot issue from them cannot have a Body for its source.

I will therefore end this Preface, with entreating my Reader to consider, that in a discourse proceeding in such order as I have declared, he must not expect to understand and be satisfied with what is said in any middle or latter part, unless he first have read and understood what goes before: Wherefore, if he cannot resolve with himself to take it along orderly as it lyes from the begining; he shall do himself (as well as me) right, not to meddle at all with this Book. But, if he will employ any time upon it, to receive advantage by it, he must be content to take the pains to understand thoroughly every particular as it is set down: And, if his memory will not serve him to carry every one along with him, yet, at least, let him be sure to remember the Place where it is handled, and, on occasion, return a look back upon it, when it may stand him in stead. If he thinks this diligence too burthensom, let him consider that the writing hereof has cost the Author much more pains. Who, as he will esteem



## PREFACE.

esteem them exceedingly well employ'd, if they may contribute ought to the content or advantage of any free and ingenuous mind; so, if any others shall express a neglect of what he has with so much labour hew'd out of the hard Rock of Nature, or shall discourteously cavil at the Notions he so freely imparts to them; all the resentment he shall make thereof will be, to desire the first to consider, that their slight esteem of his Work obliges them to entertain their thoughts with some more noble and more profitable subject, and better treated, than this is; and the Later sort, to justify their dislike of his doctrine, by delivering a far rer and more complete body of Philosophy, of their own. Which if hereupon they do, his being the occasion of the ones bettering themselves, and of the others bettering the world, will be the best success he can wish his Book.







To Sir *KENELME DIGBY*

ON

His two Incomparable Treatises

OF

**PHILOSOPHY.**

**T**Ruth's numerous Profelytes in such pompous state  
With captiv'd judgments on your Triumph wait ;  
And, mov'd by your clear Copy, Wits so rare  
Blot out their former notions to write fair :  
That 'twere a needless duty to set forth,  
In paper-gageants, your soul-conquering worth.  
Nor may Truth's Champion admit a Muse,  
(Who feigns, his commendation's but abuse.  
Unless *Lucretius* had bequeath'd to me  
His, the sworn Maid to Dame Philosophy.  
Yet ther's a Law of gratitude, which says,  
He must pay thanks, who may not offer praise.  
When with your work you entertain'd my mind,  
I was your Guest ; there I at once did find  
A Banquet and a Meal; solid and sweet,  
The rarely mingled, in one dish did meet.

( \* )

(Such



(Such diet sure, had Mankind scap't offence,  
Had bin his meat ith' State of Ignorance,)  
And now I here give thanks; which who'll not give,  
Who your perpetual Boarder means to live?  
The reading your expressions forc't me speak;  
A fancy thus charg'd needs must silence break:  
Wherefore, as Brooks to th' Sea return their streams,  
I only here reflect your borrow'd beams.

Clear-faced *Truth*, that rare unbodied light,  
Sun to our souls, (wrap't in a sin-caus'd night  
Of ignorance) who from her radiant face  
Darted forth nought but day, had found no place  
In Nature's Lordships; had not you, in fine;  
Plac't th' obscur'd Goddess in a Chrystal shrine.  
We stood like men ere they begin the Mask,  
Whose wit doth only serve to doubt and ask;  
Untill your courteous hand remov'd the Screen,  
Withdrew the curtains, and reveal'd *Truth's* Scene.  
Some, quite despairing in her quest, did say  
She in *Astræa's* Coach was flown away.  
Some said that Nature's work, on purpose t' d  
Like to the *Gordian* knot, did sub'tly hide  
It's causes and effects, none could unty't,  
As if contriv'd to puzzle, not delight.  
But most avouch't *Truth* in her old pit lay;  
And our *Cleantheses* did oft assay  
With huge-long-Cart-rope Arguments to draw  
Her upwards with their *Logick*-clunched paw:  
Bur, ah! their *Syllogistick* links all brake,  
Yet th' obstinate peece would not her hole forsake;  
Until your *Silken Linos*, or deep Wit whether,

Reason'd



Reason'd, not brawl'd her thence, & woo'd her hither.  
Trim'd up thus natively, she scorns the night,  
Nor fears t' intrust her beauty to the light:  
She through your Amber words doth brighter shine,  
Like those in Heav'n, at once both nak't and fine.  
Clad in such Tiffany-language, she grows proud  
To see her self in Cloathing, without Cloud.  
The *Schools* drest her in *Linsy-Woolsy* words;  
A stile not spun of threds, but writh'd of cords:  
Expressive barbarisms, fancy-woven air,  
Whose uncouth moustrousness would make one stare:  
An antick weed, patch't up, as they shall please,  
Of *Unions*, *Moods*, and *Senoreities*,  
Who, if they do not *Priscian* the disgrace,  
To break his head, they foully scratch his face:  
Tor'tring poor innocent *Grammar*, to confess  
The truth they hide by their dark wordishness.

But no such stuff your noble *Treatise* weats:  
It neither injures Languages, nor ears.  
Yours is a Flower-pot pay'd by Truth's rich Gold,  
While they in Dunghils rake for th' precious mold.  
Your *Stile*'s both pure and gallant, in such sort  
It makes the *Schools* speak finer than the *Court*:  
With such enlhtning Metaphor, as teach  
What sense-deluded fancy could not reach.  
Such moving Rhetorick needs no Truth desire,  
Such conquering Truths no Rhetorick's aid require,  
Yet here both joyntl' embrace, as if it was  
Truth's Legend writ by Sun-beams on clear Glasse.  
So that your Work all points of art affords,  
Where equally are learn'd neat Truths, true Words.

Fancy, our Moon, (as Reason is our Sun,)  
Which wax't and wan'd still as she wandring run,

( \* 2 )

Whose



Whose visage with unconstant Aspects shone,  
Now shuffling many things, now cutting one,  
Is taught at once to acknowledge and correct  
Her fault, which gull'd the credulous Intellect;  
And now at length is shown her double error,  
In the smooth steady Glas of Reason's mirrour.  
Here *Words*, whose whistle call'd us oft awry,  
Are taught their Origin, true sense, and why.  
Blind *Prejudice*, cur'd by a blest amaze,  
Opes wide her sullen eyes, and stands at gaze.  
All what the Universal Womb doth spawn  
Is by your *Pen* thence to the Life out-drawn.  
Your Grounds are firm and sure; who stirs the same  
May shake the World's, or stronger Reason's frame.  
*Nature* asserts them, whose *Dædalean* hand,  
Changing Particulars, makes your Generals stand.  
Here we may learn the *antientest* *Descents*,  
And the *cross* *Marriage* of the Elements;  
Whence *Nature's* numerous *Family* is bred,  
In *Kindred's* different lines distinguished.  
You show the secret gins, the springs and wires  
Which the vast Engine's motion requires;  
You nought suppose; but start your early quest,  
Where Phoenix *Nature* first doth build her Nest:  
Thence trace her laying, hatching, until she  
Brings her raw Embryo to maturity.  
The sprouting Sap, we without fiction, see  
Creepingly *metamorphos'd* to a Tree.  
We see how Eggs yield Flesh, and Bone, and Blood,  
Like creatures peece-meal shap't in *Nile's* fat mud.  
Our quivering grounds might have driv'n some perforce  
To believe *Afop*, and grant beasts discourse;  
Had



Had not your Art the pretty Knack unscrew'd  
And it's wheeles, driv'n by bloud in order, shew'd.  
Now their strange actions we may freely admire,  
Yet not about an hidden Soul enquire ;  
No more than once *Architas*' wooden Dove  
Ask't an Intelligence to make it move.  
Imaginary *Vacuums*, which are  
New terms for nothings, emptier than air,  
With *Moods* and *Qualities*, now pack away  
To lurk at home in *Terr' Incognita*.  
Crab'd *Aristotle*, who did make't his sporr  
Industrious wits should his obscureness court ;  
Whom like a darksome Cave, none durst adventure  
Without a Lantern, and a Guide to enter :  
Your grounds enlightning him, doth easier sound ;  
As *Hebrew* Consonants, when the Points were found.  
The *Soul of Man*, that intellectual All,  
Whose recreation is the World's great Ball,  
Reading her self at large here, doth descry  
An object worthy her far-spreading eye ;  
And of her nature such true notions frame,  
That she salutes her self with a new name.  
Here she may scan her Thoughts, view either State,  
How link't to matter, how when Separate ;  
Through Fancie's glass, her noble Essence spy,  
A shoreless Sea of *Immortality* ;  
In which unbounded Main you sail so fast  
Till you both lose and find your self at last.

Yet Sir, you'r justly accused by this age,  
Plain truths in difficulties to engage :  
What needed you to such nice cost proceed ?  
A *Quality* at first word had done the deed.

But



But you may nobly pity them, and grant  
 Nought's easier, than to be ignorant :  
 They rake the surface of the doubt, while you  
 Laboriously first pierce, then dig it through.  
 In moving questions *Talk* not *Truth's* their aim ;  
 As Lords start Hares, not for the *prey*, but *game*.  
 They spring, then stoop at some slight Butter-fly ;  
 Thus some in hunting only love the Cry.  
 This is the utmost art with which they're stor'd,  
 To call Truth some unanswerable word ;  
 Which holds the field, untill some active wit,  
 Working at Fanci's mintage, chance to hit  
 Upon a quainter, which cuts that in twain,  
 And triumphs, till a third cleaves it again.  
 Thus these *Tenedian* Axes hew each other ;  
 Like *Cadmu's* armed crop, each slays his brother.  
 Since with Distinctions they so nicely pare,  
 They subtilize it quite away to air.  
 These *Authors* yet, voluminously-vain,  
 Stuff Libraries With Monsters of their brain ;  
 Whose fruitless toil is but the same, or less,  
 To plant *bryar-fields* t'enlarge a *wilderness*.

How hard to rectifie that *ravell'd* clue,  
 On your own *bottom* winding't up a new !  
 Yet this you did, by th' guidance of *his* light,  
 Who was your *Plato*, you his *Stagyrite* ;  
 (Save that his Doctrine's such, you could invent,  
 In *Truth's* behalf, no reason to dissent.)

\* Mr. Tho- Even \* *That Great Soul*, which fathoms th' *Universe*,  
 mas White. Doth, to the center, *Natures* entrails pierce ;  
 Girdles the *World*, and, as a pair of beads,  
 On Reason's link the *Starry* bodies threads ;

Un-



Unspells the *Heaven's* broad volume, views so clear  
Of active *Angels*, th' higher Hemisphere,  
And this of *Bodies*, 'cause he first begun  
His search by studying *Man*, their *Horizon*:  
Whom Heaven reserves *Divinity* to weed  
From Words o'regrowing the Diviner Seed.  
To use your own, 'cause no expression's higher,  
*These sparks you kindled at his great fire,*  
And round about in thorow-light papers hurl'd,  
Will shortly enlighten and enflame a World.

*John Serjeant.*

---



Handwritten text in a cursive script, likely a letter or a page from a manuscript. The text is faint and difficult to decipher.

1735





FIRST TREATISE:  
DECLARING THE  
NATURE and OPERATION  
OF  
BODIES.

---

CHAP. I.

*A Preamble to the whole discourse: Concerning Notions in general.*

**I**N delivering any Science, the clearest and smoothest Method, and most agreeable to Nature, is to begin with the consideration of those things that are most Common and obvious; and by the dissection of them, to descend by orderly degrees and Stepps (as they lye in the way) to the examination of the most Particular and remote ones. Now, in our present intended Survey of a Body, the first thing, which occurs to our Sense in the perusal of it, is its Quantity, bulk, or magnitude. And this seems to be conceiv'd by all Mankind so inseparable from a Body, as that, when a man would distinguish a Corporeal Substance from a Spiritual one (which is accounted indivisible), he naturally pitches on an apprehension of its having bulk, and being solid, tangible, and apt to make impression on our outward senses: according to that expression of *Lucretius*, who, studying Nature in a familiar and rational manner, tells us, *Tangere enim & tangi, nisi Corpus nulla potest res.* And therefore, in our inquiry of Bodies, we will observe that plain Method which Nature teaches us; and begin with examining what Quantity is: as being their

*Quantity is the first and most obvious affection of a Body.*

A first



first and primary affection) and that which makes the things we treat of be what we intend to signifie by the name of *Body*.

<sup>2</sup> But, because there is a great variety of Apprehensions framed by learned men of the nature of *Quantity* (though indeed nothing can be more plain and simple then it is in it self) I conceive it will not be amiss, before we enter into the explication of it, to consider how the mystery of discoursing and expressing our Thoughts to one another by Words (a prerogative belonging only to Man) is order'd and govern'd among us: that so we may avoyd those rocks, which many, and for the most part such as think they spin the finest threds, suffer shipwrack against in their subtilest discourses. The most dangerous of all which assuredly is, when they confound the true and real Natures of things, with the Conceptions they frame of them in their own minds. By which fundamental miscarriage of their reasoning, they fall into great errors and absurdities: and whatever they build on so ruinous a foundation proves but useless cobwebs or prodigious *Chymeras*. 'Tis true, words serve to express things; but, if you observe the matter well, you will perceive they do so, onely according to the Pictures we make of them in our own thoughts, and not according as the Things are in their proper natures. Which is very reasonable it should be so, since the Soul, that gives the Names, has nothing of the things in her but these Notions, and knows not the Things otherwise then by these Notions: and therefore cannot give other Names, but such as must signifie the Things by mediation of these Notions. In the Things all that belongs to them is comprised under one entire Entity; but in Us there are fram'd as many several distinct formal Conceptions, as that one Thing shews it self to us with different faces: Every one of which conceptions seems to have for its object a distinct Thing; because the Conception it self is as much sever'd and distinguish'd from another Conception or Image, arising out of the very same Thing that begot this, as it can be from any image painted in the understanding by an absolutely other Thing.

<sup>3</sup> The first error that may arise from hence, It will not be amiss to illustrate this matter by some familiar Example. Imagin I have an Apple in my hand; the same Fruit works different effects upon my several Senses: my Eye tells



tells me 'tis green or red; my Nose that it hath a mellow scent, which is a multiplying of Things, where no such multiplication is really found: my Taste that it is sweet; and my Hand that it is cold and weighty. My *Senses*, thus affected, send messengers to my *Phantasie* with news of the discoveries they have made: and there, all of them make them several and distinct pictures of what enters by their doors. So that my *Reason* (which discoursed on what it finds in my phantasie) can consider greenness by it self, or mellowness, or sweetness, or coldness, or any other quality whatever, singly and alone by it self; without relation to any other that is painted in me by the same Apple: in which none of these have any distinction at all, but are one and the same Substance of the Apple, that makes various and different impressions on me, according to the various dispositions of my several Senses; as hereafter we shall explicate at large. But, in my mind, every one of these Notions is a distinct Picture by it self; and as much sever'd from any of the rest arising from the same apple, as it would be from any impression or image made in me by a Stone or any other substance whatever that, being entire in it self and circumscribed within its own circle, is absolutely sequestred from any communication with the other. So that, what is but one entire thing in it self, seems to be many distinct things in my understanding: wherby, if I be not very cautious, and in a manner, wrestle with the bent and inclination of my Understanding, which is apt to refer the distinct and complete stamp it finds within it self, to a distinct and complete original Character in the Thing, I shall be in danger before I am aware, to give actual Beings to the quantity, figure, colour, smel, tast, and other accidents of the Apple, (each of them distinct one from another, as also from the Substance which they clothe), because I find the notions of them really distinguish'd, as if they were different Entities in my mind. And from thence I may infer, there is no contradiction in nature to have the Accidents really sever'd from one another, and to have them actually subsist without their Substance: and such other mistaken subtilties, which arise out of our unwary conceiting that things are in their own Natures, after the same fashion as we consider them in our Understanding.



4.  
A second error; the conceiving of many distinct things, as really one thing.

And this course of the minds disguising and changing the impressions it receives from outward objects, into appearances quite differing from what the things are in their own real natures, may be observ'd not only in multiplying Entities where in truth there is but one; but also, in a contrary manner, by comprising several distinct Things under one single Notion : which, if afterwards it be reflected back upon the things themselves, is the occasion of exceeding great errors, and entangles one in unsuperable difficulties. As for example; Looking upon several Cubes or Dyce, wherof one is of gold, another of lead, a third of ivory, a fourth of wood, a fifth of glass, and what other matter you please : all these several things agree together in my Understanding, and are there comprehended under one single notion of a Cube; which (like a Painter, that were to designe them only in black and white) makes one figure that represents them all. Now, if removing my consideration from this impression which the several cubes make in my understanding, to the cubes themselves, I shall unwarily suffer my self to pin this one notion upon every one of them, and accordingly conceive it to be really in them; it will of necessity fall out, by this misapplying of my intellectual notion to the real things, that I must allow Existence to other entities, which never had nor can have any in nature.

From this conception *Plato's Idea's* had their birth. For, finding in his understanding one Universal notion, that agreed exactly to every Individual of the same *Species* or Substance which imprinted that notion in him; and conceiving that the picture of any thing must have an exact correspondence with the thing it represents; and not considering that this was but an imperfect picture of the individual that made it : he thence conceiv'd, there was actually in every individual Substance one universal Nature running through all of that *species*, which made them be what they were. And then, considering that corporeity, quantity, and other accidents of Matter, could not agree with this universal subsistent Nature, he denyed all those of it; and so, abstracting from all materiality in his *Idea's*, and giving them a real and actual subsistence in nature, he made them like *Angels*, whose essences and formal reasons were to be the



the Essence and to give Existence to corporeal individuals; and so each Idea was embodied in every individual of its *species*. To which opinion (and upon the same grounds) *Averroes* lean'd, in the particular of mens Souls. Likewise *Scotus*, finding in his understanding an Universal notion springing from the impression that Individuals make in it, will have a like Universal in the thing it self; so determining Universals (to use his own language and terms) to be *à parte rei*, and expressing the distinction they have from the rest of the thing, by the terms of *actus formaliter, sed non realiter*: and thereby makes every individual comprise an universal subsistent nature in it. Which inconvenience other modern Philosophers, seeking to avoid, will not allow these Universals a real and actual subsistence, but lend them only a fictitious Being; so making them, as they call them, *Entia rationis*. But herein again they suffer themselves to be carried down the stream, before they are aware, by the understanding (which is apt to pin upon the objects the notions it finds within it self resulting from them); and consider an Unity in the things, which indeed is only in the Understanding.

Therefore one of our greatest cares in the guidance of our discourse, and a continual and sedulous caution therein, ought to be used in this particular; where every error is a fundamental one, and leads into inextricable labyrinths, and where that which is all our level to keep us upright and even (our Understanding) is so apt, by reason of its own nature and manner of operation, to make us slide into mistaking and error. And (to sum up in short what this discourse aims at) we must narrowly take heed, lest, reflecting upon the notions we have in our mind, we afterwards pin those airy superstructures upon the material things themselves that begot them, or frame a new conception of the nature of any thing by the negotiation of our understanding, upon those impressions which it self makes in us; whereas we should acquiesce and be content with that natural and plain notion, which springs immediately and primarily from the thing it self: which when we do not, the more we seem to excel in subtilty, the further we go from reality and truth; like an Arrow which, being wrong levell'd at hand, falls widest when shot in the strongest bow.

5.

Great care to be taken, to avoid the errors which may arise from our manner of understanding things.



6  
Two sorts of  
words to ex-  
press our noti-  
ons; the one  
common to all  
men, the other  
proper to  
Scholars.

Now, to come to another point that makes to our present purpose. We may observe there are two sorts of language to express our notions by. One belongs in general to all mankind, and the simplest person, that can but apprehend and speak sense, is as much judg of it as the greatest Doctor in the Schools; and, in this, the words express the things properly and plainly, according to the natural conceptions that all people agree in making of them. The other sort of language is circled in with narrower bounds, and understood only by those that, in a particular express manner, have been train'd up to it: and many of the words which are proper to it have been, by the Authors of it, translated and wrested from the general conceptions of the same words, by some metaphor, or similitude, or allusion, to serve their private turns. Without the first manner of expressing our notions, mankind could not live in society together, and converse with one another: whereas, the other has no further extent, then among such persons as have agreed together, to explicate and design among themselves particular notions peculiar to their arts and affairs.

Of the first kind are those ten general heads, which *Aristotle* calls *Predicaments*: under which he (who was the most judicious orderer of notions and director of mens conceptions, that ever lived) hath comprised whatever has, or can have, a *being* in nature. For, when any object occurs to our thoughts, we either consider the essential and fundamental Being of it; or we refer it to some *species* of Quantity; or we discover some Qualities in it; or we perceive that it Does, or Suffers something; or we conceive it in some determinate Place or Time, and the like: Of all which every man living, that injoys but the use of reason, finds naturally within himself, at the very first naming of them, a plain, complete, and satisfying notion; which is the same, without any the least variation, in all mankind, unless it be in such as have, industriously, and by force, and with much labour, perplex'd and deprav'd those primary and sincere impressions, which nature had freely made in them.

Of the second sort are the particular words of art, by which



which learned men use to express what they mean in Sciences; and the names of Instruments, and of such things as belong to Trades, and the like: as a Sine, a Tangent, an Epicycle, a Deferent, an Axe, a Trowel, and such others; the intelligence of which belongs not to the generality of mankind, but only to the Geometricians, Astronomers, Carpenters, Masons, and such persons as converse familiarly and frequently with those things. To learn the true signification of such words, we must consult with those that have the knowledge and practice of them: as, in like manner, to understand the other kind of plain language, we must observe how the words that compose it are apprehended, used, and applyed by mankind in general; and not receive into this examination the wrested or Metaphorical senses of any learned men, who seek oftentimes (beyond any ground in nature) to frame a general notion that may comprehend all the particular ones; which in any sense, proper or improper, may arise out of the use of one word.

And this is the cause of great errors in discourse; so great and important, as I cannot too much inculcate the caution requisite to the avoyding of this rock. Which that it may be the better apprehended, I will instance in one example of a most plain and easie conception, wherein all mankind naturally agrees; how the wresting it, from its proper, genuine, and original signification, leads one into strange absurdities: and yet they pass for subtil speculations. The notion of *being in a place* is naturally the same in all men living. Ask any simple Artisan, Where such a man, such a house, such a tree, or such a thing is? and he will answer you in the very same manner as the learnedest Philosopher would doe. He'll tell you, the Man you ask for is in such a Church, sitting in such a Piew, and in such a Corner of it;) that the House you inquire after is in such a Street, and next to such two Buildings on each side of it;) that the Tree you would find out is in such a Forest, upon such a Hill, near such a Fountain, and by such a Bush; that the Wine you would drink of is in such a Cellar, in such a Part of it, and in such a Cask: In conclusion, no man living, that speaks naturally and freely out of the notion he finds clearly in his understanding, will give you

7.  
Great errors arise, by wresting words from their common meaning, to express a more particular or studied notion



other answer to the question of, where a thing is, then such a one as plainly expresses his conceit of being *in place* to be no other, then *bodies being environ'd and inclos'd by some one or several others, that are immediate to it*; as the place of a liquor is the vessel that contains it, and the place of the vessel is such a part of the chamber or house that it rests on, together with the ambient Air, which has a share in making up the places of most things. And this being the answer, that every man whatever will readily give to this question; and every asker being fully satisfied with it: we may safely conclude, That all their notions and conceptions of *being in a place* are the same; and consequently, that it is the natural and true one.

But then, some others, considering that such conditions as these will not agree to other things, which they likewise conceit to be *in a place* (for they receive it as an axiom from their sense, that whatever is, must be somewhere, and whatever is no where is not at all); they fall to casting about how they may frame some common notion, to comprehend all the several kinds of being in place, which they imagine in the things they discourse of. If there were nothing but *Bodies* to be rank'd by them in the *Predicament of Place*, then that description, I have already set down, would be allow'd by them as sufficient. But, since that *Spirits* and *Spiritual things* (as Angels, Rational Souls, Verities, Sciences, Arts, and the like) have a *being in Nature*; and yet will not be comprised in such a kind of *place* as a Body is contain'd in; they rack their thoughts to speculate out some common notion of being *in place*, which may be common to these, as well as to Bodies; like a common accident agreeing to divers subjects. And so, in the end, they pitch on an Entity, which they call an *Ubi*: and they conceit the nature and formal reason of that to be, the ranking of any thing in a place, when that Entity is thereto affixed. And then they have no further difficulty, in settling an Angel, or any pure Spirit, or immaterial Essence, in a place as properly, and as completely, as if it were a Corporal Substance. 'Tis but assigning an *Ubi* to such a Spirit, and he is presently riveted to what place you please: And, by multiplying the *Ubis*,  
any



any individual body, to which they are assign'd, is, at the same instant, in as many distant places, as they allot it different *Ubi*: And, if they assign the same *Ubi* to several bodies, so many several ones, as they assign it to, will be in one and the same place: And, not only many bodies in one place, but even a whole body in an indivisible, by a kind of *Ubi* that has a power to resume all the extended parts and inclose them in a point of place. All which prodigious conceits and impossibilities in nature spring out of their mistake, in framing Metaphysical and abstracted conceptions; instead of contenting themselves with those plain, easie, and primary notions, which Nature stamps alike in all men of common sense and understanding. As, who desires to be further instructed in this particular may perceive, if he take the pains to look over what *Mr. White* hath discours'd of Place, in the first of his *Dialogues De Mundo*. To which Book I shall from time to time (according as I shall have occasion) refer my Reader, in those subjects the Author takes upon him to prove: being confident that his Metaphysical Demonstrations there are as firm, as any Mathematical ones, (for Metaphysical Demonstrations have in themselves as much firmness, certainty, and evidence as they); and will appear as evident to whoever shall understand them thoroughly, and frame right conceptions of them: which (how plain soever they seem) is not the work of every pretender to learning.

## CHAP. II.

## Of Quantity.

**A**Mong those primary affections which occur in the perusal of a Body, Quantity (as I have observ'd in the precedent Chapter) is one, and, in a manner, the first and root of all the rest. Therefore (according to the caution we have been so prolix in giving, because it is of so main importance), if we aim at right understanding the true nature of it, we must examin what apprehension all kinds of people (that is, mankind in general) make of it. By which proceeding, we do not make the ignorant Multitude judg of that Learning, which grows out of the consideration of Quantity: but only

I.  
We must know  
the vulgar,  
and common  
notion of  
Quantity, that  
we may un-  
derstand the  
nature of it.



ly of the natural notion, which serves learned men for a *basis* and foundation to build Scientifical superstructures on. For, though Sciences be the works and structures of the understanding, govern'd and level'd by the wary and strict rules of most ingenuous Artificers; yet the ground on which they are rais'd are such plain notion of things as, naturally and without any art, present themselves to every mans apprehension: without which for matter to work upon, those artificial reflections would leave the understanding as unsatisfied; as a Cook would the appetite, by a dish upon which he should have exercised all his art in dressing it, but whose first substance were not meat of solid nutriment. 'Tis the course Market that must deliver him plain materials to imploy his cunning on: And, in like manner, 'tis the indisciplin'd Multitude that must furnish learned men with natural apprehensions and notions to exercise their wits about. Which when they have, they may use and order and reflect upon them as they please: but they must first receive them in that plain and naked form, as mankind in general pictures them out in their imaginations.

And therefore the first work of *Scholars* is, to learn of the People (*Quem penes arbitrium est & jus & norma loquendi*) what is the true meaning and signification of these primary names; and what notions they beget, in the generality of mankind, of the things they design. Of the Common People, then, we must enquire What Quantity; is and we shall soon be informed, if we but consider what answer any sensible man will make on the sudden, to a question wherof that is the subject; for, such unstudied replies express sincerely the plain and natural conceptions which they that make them have of the things they speak of. And this, of Quantity, is the plainest and the first that nature prints in us, of all the things we see, feel, and converse with; and that must serve for a ground to all our other inquiries and reflections: for which cause we must be sure not to receive it wrested or disguised from its own nature.

2.  
Extension or  
Divisibility is  
the common  
notion of  
Quantity.

If then any one be asked, What Quantity there is in such a thing, or how great it is; he will presently in his understanding compare it with some other thing (equally known by both parties)



parties) that may serve for a measure to it : and then answer, That it is as big as it, or twice as big, or not half so big, or the like, in fine, that it is bigger or lesser then another thing, or equal to it.

'Tis of main importance to have this point thoroughly and clearly understood ; therefore it will not be amiss to turn it and view it a little more particularly. If thou ask what *Quantity* there is of such a parcel of Cloth, how much Wood in such a piece of Timber, how much Gold in such an Ingot, how much Wine in such a Vessel, how much Time was taken up in such an Action? he that is to give you an account of them measures them by ells, by feet, by inches, by pounds, by ounces, by gallons, by pints, by days, by hours, and the like ; and then tells you, how many of those parts are in the whole that you inquire of. Which answer every man living will at the instant, without study, make to this question ; and with it every man, that shall ask, will be fully appay'd and satisfied : so that 'tis most evident, it fully expresses the notions of them both, and of all mankind, in this particular.

Wherefore, when we consider that *Quantity* is nothing else, but the *Extension* of a thing; and that this *Extension* is express'd by a determinate number of lesser extensions of the same nature; ( which lesser ones are sooner and more easily apprehended then greater, because we are first acquainted and conversant with such, and our understanding grasps, weighs and discerns such more steadily; and makes an exacter judgment of them; ) and that such lesser ones are in the greater which they measure, as parts in a whole ; and that the whole, by comprehending those parts, is a mere capacity to be divided into them ; we conclude, That *Quantity* or *Bigness* is nothing else but *Divisibility*; and that a thing is *big*, by having a capacity to be divided; or ( which is the same ) to have parts made of it.

This is yet more evident (if more may be) in *Discrete Quantity* ( that is, in *Number* ) then in *Continued Quantity*, or *Extension*. For, if we consider any number whatever, we shall find the essence of it consists in a capacity of being resolv'd and divided into so many *Unities*, as are contain'd in it ; which are the parts of it. And this *species* of *Quantity*; being simpler then the other, serves for a rule to determine it by : as we may observe



observe in the familiar answers to questions of Continued Quantity, which express by number the Content of it; as, when one delivers the Quantity of a piece of ground, by such a number of furlongs, acres, perches, or the like.

3  
Parts of  
Quantity are  
not actually in  
their whole.

But we must take heed of conceiving, that those *parts*, which we consider to discern the nature of Quantity, are actually and really in the whole of any continued one that contains them. Ells, feet, inches, are no more real Entities in the whole that is measur'd by them, and makes impressions of such notions in our Understanding; then, in our former example, colour, figure, mellowness, tast, and the like, are several substances in the Apple, that affects our several Senses with such various impressions. 'Tis but one whole, that may indeed be cut into so many several *parts*; but those *parts* are not really there, till by division they are parceled out: and then, the whole (out of which they are made) ceases to be any longer; and the *parts* succeed in lieu of it, and are every one of them a new whole.

This truth is evident out of the very definition we have gather'd of *Quantity*. For, since it is Divisibility, that is, a bare capacity to division; it follows, that it is *not yet* divided: and consequently, that those *parts* are *not yet* in it, which *may be* made of it; for, division is the making two or more things of one.

4  
If parts were  
actually in  
their whole,  
Quantity  
would be com-  
posed of indi-  
visibles.

But, because this is a very great controversie in *Schools*, and so important to be determin'd and settled, as, without doing so, we shal be liable to main errors in searching the nature and operations of Bodies; and that the whole progress of our discourse will be uncertain and wavering, if this principle and foundation be not firmly laid: we must apply our selves to bring some more particular and immediate proof of the verity of this assertion. Which we wil doe, by shewing the inconvenience, impossibility, and contradiction, that the admittance of the other leads to. For if we allow *actual parts* to be distinguish'd in Quantity, it wil follow that 'tis composed of *points* or *indivisibles*, which we shall prove to be impossible.

The first wil appear thus: if Quantity were divided into all the parts into which 'tis divisible, it would be divided into indivisibles (for nothing divisible, and not divided, would remain in it); but it is distinguish'd into the same parts into which it



it would be divided, if it were divided into all the parts into which 'tis divisible; therefore it is distinguish'd into indivisibles. The *major* proposition is evident to any man that has eyes of understanding. The *minor* is the confession, or rather the position, of the adversary; when he says that all its parts are actually distinguished. The consequence cannot be calumniated, since indivisibles, whether they be separated or joyn'd, are still but indivisibles; though that which is composed of them be divisible. It must then be granted that all the parts, which are in Quantity, are indivisibles; which parts being actually in it, and the whole being composed of these parts only, it follows, that Quantity is composed and made of indivisibles.

If any should cavil at the supposition, and say, we stretch it further than they intend it, by taking all the parts to be distinguished: whereas they mean only that there are parts actually in Quantity, abstracting from all; by reason that all, in that matter, would infer an infinity, which, to be actually in any created thing, they will allow impossible. Our answer will be, to represent to them how this is barely said, without any ground or colour of reason; merely to evade the inconvenience the argument drives them to. For, if any parts be actually distinguish'd, why should not all be so? What prerogative have some that the others have not? And how came they by it? If they have their actual distinction, out of their nature of being *parts*; then all must enjoy it alike, and all be equally distinguished, as the supposition goes: and they must all be indivisibles, as we have proved. Besides, to prevent the cavil upon the word all, we may change the expression of the Proposition into a negative: for, if they admit (as they do) that there is no part in Quantity but is distinguish'd as far as it may be distinguish'd; then the same conclusion follows with no less evidence; and all will prove indivisibles, as before.

But 'tis impossible that indivisibles should make Quantity, for if they should, it must be done either by a finite and determinate number, or by an infinite multitude of them. If you say by a finite, let us take (for example) three indivisibles, and, by adding them together, let us suppose a *line* composed; whose extent being only longitude, 'tis the first and simplest *species* of Quantity; and therefore whatever is divisible into parts

5.  
Quantity cannot be composed of indivisibles.



parts must be at least a line. This line thus made cannot be conceiv'd to be divided into more parts than three; since doing so you reduce it into the indivisibles that compos'd it. But *Euclide* hath demonstratively proved beyond all cavil (in the *Tenth Proposition* of his *Sixth Book of Elements*), that any line whatever may be divided into whatever number of parts; so that, if this be a line, it must be divisible into an hundred, or a thousand, a million of parts: which being impossible in a line, divided into three parts only, wherof every one is incapable of further division: it is evident, that neither a line, nor any Quantity whatever, is compos'd or made of a determinate number of indivisibles.

And, since this capacity, of being divisible into infinite parts, is a property belonging to all extension (for *Euclide's* demonstration is universal); we must needs confess that 'tis the nature of indivisibles, when joyn'd together, to be drown'd in one another; for, otherwise, there would result a kind of extension out of them, which would not have that property; contrary to what *Euclide* has demonstrated. And from hence it follows, that Quantity cannot be compos'd of an infinite multitude of such indivisibles: for, if this be the nature of indivisibles, though you put never so great a number of them together, they will still drown themselves all in one indivisible point. For, what difference can their being infinite bring to them, of such force as to destroy their essence and property? If you but consider how the essential composition of any Multitude whatever is made, by the continual addition of Unities, till that number arise; 'tis evident, in our case, that the infinity of indivisibles must also arise, out of the continued addition of still one indivisible to the indivisibles presuppos'd. Then, let us apprehend a finite number of indivisibles, which (according as we have proved) make no extension, but are all drowned in the first: and observing how the progress to an infinite multitude goes on, by the steps of one and one, added still to this presuppos'd number: we shall see that every indivisible added, and consequently the whole infinity, will be drown'd in the first number, as that was in the first indivisible.

Which will be yet plainer, if we consider, that the nature of extension



extension requires one part be not in the same place, where the other is: then, if the extension be composed of indivisibles, let us take two points of place in which this extension is; and inquire, whether the indivisibles in each of these points be finite or infinite. If it be answer'd that they are finite, then the finite indivisibles in these two points make an extension, which we have proved impossible: But if they be said to be infinite, then infinite indivisibles are drown'd in one point; and consequently have not the force to make extension. Thus then it remains firmly establish'd, *That* Quantity is not composed of indivisibles (neither finite, nor infinite ones) and consequently, *That* parts are not actually in it.

Yet, before we leave this point, though we have already been somewhat long about it, I conceive it will not be tedious, if we be yet a little longer; and bend our discourse to remove a difficulty, that even Sense it self seems to object to us. For, doth not our eye evidently inform us, there are fingers, hands, arms, legs, feet, toes, and variety of other parts in a Mans Body? These are actually in him, and seem to be distinct things in him; so evidently, that we cannot be perswaded, but that we see and feel the distinction between them: for, every one of them has a particular power of actual working and doing what belongs to its nature; each finger is really there, the hand is different from the foot, the leg from the arm, and so of the rest. Are not these parts then actually and really in a mans body? And is not each of them as really distinguish'd from any other?

This appears at first sight to be an insuperable Objection; because of the confirmation and evidence that Sense seems to give it: But, looking nearly into the matter, we shall find that the difficulty arises, not from what Sense informs us of, but from our wrong applying the conditions of our notions, to the things that make impressions upon our Sense. Sense judges not which is a finger, which is a hand; or which is a foot. The notions agreeing to these words, as well as the words themselves, are productions of the Understanding; which, considering several impressions made upon the Sense by the same thing, as it has a vertue and power to several operation, frames several notions of it: as, in our former example, it doth  
of

6  
An objection  
to prove that  
parts are actu-  
ally in Quan-  
tity; with a  
declaration  
of the mistake  
from whence  
it proceed.



of colour, figure, taste, and the like, in an Apple. For, as these are not different bodies or substances distinguish'd one from another; but are the same one entire thing, working severally upon the Senses, and that accordingly makes these different pictures in the mind, which are there as much distinguish'd as if they were pictures of different substances: So, the parts consider'd in Quantity *are not* divers things, but only a virtue or *power to be* divers things; which virtue, making several impressions upon the Senses, occasions several notions in the Understanding. And the Understanding is so much the more prone to conceive those parts as distinct things, by how much Quantity is nearer to be distinct things, than the Qualities of the Apple are. For, Quantity is a possibility to *be* made distinct things by division; whereas the others are but a virtue to *doe* distinct things. And yet (as we have touch'd above) nothing can be more manifest, than that, if Quantity be Divisibility (which is, a possibility that many things may be made of it), these parts are not yet divers things. So that, if (for example) a rod be laid before us, and half of it be hid from our sight, and the other half appear; it is not one part or thing that shews it self, and another part or thing that doth not shew it self: but it is the same rod or thing which shews it self according to the possibility of being one new thing; but doth not shew it self according to the possibility of being the other of the two things it may be made by division. Which example, if it be well consider'd, will make it much more easily sink into us, that a hand, or eye, or foot, is not a distinct thing by it self; but that it is the man, according as he hath a certain virtue or power in him to distinct operations. For, if you sever any of these parts from the whole body, the hand can no more hold, nor the eye see, nor the foot walk; which are the powers that essentially constitute them to be what they are: and therefore they are no longer a hand, an eye, or a foot.

7  
The solution  
of the former  
objection: and  
that Sense and  
not discern  
whether one  
part be distin-  
guish'd from  
another, or no.

Now then, to come to the objection; let us examine how far Sense may be allow'd to be judge in this difficulty, and we shall find, that Sense cannot determine any one part in a body; For, if it could, it would precisely tel, where that part begins or ends: but, it being agreed on that it begins and ends in indivisibles, 'tis certain, that Sense cannot determine of them.

If



If then Sense cannot determine any one part; how shall it see that it is distinguish'd from all other parts? Again, considering that all that whereof Sense is capable is divisible, it still tells us that, in all it sees, there are more parts then one, and therefore it cannot discern nor inform us of any that is one alone, nor knows what it is to be *one*, for it never could discern it: but what is *many* is *many* ones, and cannot be known by that which knows not what it is to be *one*: and consequently Sense cannot tell us, that there are many. Wherefore 'tis evident, that we may not rely upon Sense for this question. And, as for Reason, she has already given her verdict.

So that nothing remains but to shew, why we talk as we do, in ordinary discourse, of *many parts*: and that what we say in that kind is true, notwithstanding the *unity* of the *thing*. Which will appear plainly, if we consider that our Understanding hath a custome, for the better discerning of things, to impose on a thing, as it is under one notion, the exclusion of it self as it is under other notions. And this is evident to all Scholars, when the mark of exclusion is expressly put; as when they speak of a white thing, adding the reduplication, as white; which excludes all other considerations of that thing besides the whiteness of it. But when it comes under some particular name of the thing, it may deceive those that are not cunning: though, indeed, most men discover it in such names as we call abstracted; as Humanity, Animality, and the like. But, it easily deceives when it comes in Concrete names; as it doth in the name of Part in general, or in the names of particular parts, as an hand, an eye, an inch, an ell, and others of the like nature: for, as you see that a part excludes both the notion of the whole, and of the remaining parts; so doth a hand, an eye, an ell, exclude all the rest of that thing, whereof the hand is an hand, and the ell is an ell, and so forth. Now then, as every man sees evidently that it cannot be said, the Wall, *as white*, is Plaister or Stone: no more can it be said, that the Hand of a Man is his Foot; because the word hand signifies as much in it self, as if the man were taken, by reduplication, to be the man *as he is hand*, or as he hath the power of holding. So likewise, in the rod we spoke of before, it cannot be said that the part seen is the part unseen; because the part

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seen,



seen signifies the rod, as it is a possibility to be made by division such a thing as it appears to the sight. And thus 'tis clear, how the difficulty of this point arises out of the wrong applying the conditions of our notions, and of names, to the objects and things which we know: whereof we gave warning in the beginning.

Chap. 2. S. 2. 3.  
8.

An enumeration of the several specieses of Quantity; which confirms that the essence of it is divisibility.

After which there remains no more to be said of this subject, but to enumerate the several specieses of Quantity, according to that division which Logicians, for more facility of discourse, have made of it. Namely, these six, *Magnitude, Place, Motion, Time, Number, and Weight*. Of which, the two first are *Permanent*, and lie still exposed to the pleasure of whoever has a mind to take a survey of them. Which he may do by measuring what parts they are divisible into; how many ells, feet, inches a thing is long, broad, or deep; how great a place is, whether it be not bigger or lesser than such another; and by such considerations as these; which all agree in this, that they express the essence of those two specieses of Quantity, to consist in a Capacity of being divided into parts.

The two next, *Motion and Time*, though they be of a fleeting propriety, yet 'tis evident that, in regard of their original and essential nature, they are nothing else but a like divisibility into parts; which is measured by passing over so great or so little distance, and by years, days, hours, minutes, and the like. *Number*, we also see is of the same nature; for it is divisible into so many determinate parts; and is measured by unities, or by lesser numbers so or so often contain'd in a proposed greater. And the like is evident of *Weight*, which is divisible into pounds, ounces, drams, or grains; and by them is measured. So that, looking over all the several specieses of Quantity; 'tis evident, our definition of it is a true one, and expresses fully the essence of it, when we say it is *Divisibility*, or a Capacity to be divided into parts: and that no other notion whatever, besides this, reaches the nature of it.



## CHAP. III.

## Of Rarity and Density

I Intend in this Chapter to look, as far as I can, into the nature and causes of the two first differences of Bodies; which follow out of Quantity, as it concurs with Substance to make a Body: for, the discovery of them, and of the various proportions of them among themselves, will be a great and important step in the journey we are going. But the scarcity of *our language* is such, in subjects remov'd from ordinary conversation, (though, in others, I think none is more copious or expressive) as affords us not apt words of our own to express significantly such notions as I must busie my self about in this discourse: therefore I will presume to borrow them from the *Latine School*, where there is much adoe about them. I would express the difference between bodies that, under the same measures and outward bulk, have a greater thinness and expansion, or thickness and solidity, one than another; which terms, (or any I can find in *English*) do not signifie fully those differences of Quantity which I intend here to declare: therefore I will do it under the names of *Rarity* and *Density*; the true meaning of which will appear by what we shall hereafter say.

1.  
What is meant  
by *Rarity* and  
*Density*.

'Tis evident to us, that there are different sorts of Bodies, of which though you take equal quantities in one regard, yet they will be unequal in another. Their magnitudes may be the same, but their weights will be different; or contrarywise, their weights being equal, their outward measures will not be so. Take a pinte of Air, and weigh it against a pinte of Water, and you will see the ballance of the last go down amain; but if you drive out the Aire by filling the pinte with Lead, the other pinte in which the Water is, will rise again as fast: which if you pour out, and fill that pinte with Quicksilver, you will perceive the Lead to be much lighter; and again you will find a pinte of Gold heavier then so much Mercury. And in like manner, if you take away of the heavy bodies till they agree in weight with the lighter, they will take up & fill different proportions and parts of the measure that shall contain them.

2.  
'Tis evident  
that some bo-  
dies are *rare*.  
and others  
*dense*; though  
obscure, how  
they are such.

But, whence this effect arises, is the difficulty we would



lay open. Our measures tell us their quantities are equal; and reason assures us there cannot be two bodies in one and the same place; therefore, when we see a pinte of one thing outweighs a pinte of another that is thinner, we must conclude there is more body compacted together in the heavy thing than in the light; for else, how could so little of a solid or dense thing be stretch'd out to take up so great room, as we see, in a basin of water that, being rarified into smoke or air, fills the whole chamber? and again, shrink back into so little room, as when it returns into water or is contracted into ice? But, how this comprehension of more body in equal room is effected, doth not a little trouble Philosophers.

3.  
A brief enumeration of the several properties belonging to rare and dense bodies.

To find a way that may carry us through these difficulties arising out of the *Rarity* and *Density* of Bodies, let us do as *Astronomers*, when they inquire the motions of the Spheres and Planets: they take all the *Phenomena* or several appearances of them to our eyes, and then attribute to them such Orbs, courses, and periods, as may square and fit with every one of them; and, by supposing them, they can exactly calculate all that will ever after happen to them in their motions. So, let us take into our consideration the chief properties of rare and dense bodies; and then cast with our selves to find out an *hypothesis* or supposition (if it be possible) that may agree with them all.

First, it seems to us that dense bodies have their parts more close and compacted, than others have that are more rare and subtile. Secondly, they are more heavy than rare ones. Again, the rare are more easily divided than the dense bodies: for water, oyl, milk, honey, and such like substances, will not only yield easily to any harder thing, than shall make its way through them, but they are so apt to division and to lose their continuity, that their own weights will overcome and break it; whereas, in iron, gold, marble, and such dense bodies, a much greater weight and force is necessary to work that effect. And indeed, if we look well into it, we shall find that the rarer things are as divisible in a lesser Quantity, as the more dense are in a greater: and the same force will break the rarer thing into more and lesser parts, than it will an equal one that is more dense. Take a Stick of light wood, of such a big-  
ness



ness that, being a foot long, you may break it with your hands; and another of the same bigness, but of a more heavy and compacted wood, and you shall not break it, though it be two foot long: and, with equal force, you may break a loaf of bread, into more and less parts, then a lump of lead that is of the same bigness. Which also will resist more to the division of Fire (the subtillest divider that is) then so much water will. For the little atomes of fire (which we shall discourse on hereafter) will pierce & cut out the water, almost into as little parts as themselves; and, mingling themselves with them, they will flie away together, and so convert the whole body of water into subtile smoke: whereas the same Agent, after long working upon lead, will bring it into no less parts then small grains of dust, which it calcines it into. And gold that is more dense then lead, resists peremptorily all the dividing power of fire; and will not at all be reduced into a calx or lime, by such operation as reduced lead into it.

So that, remembring how the nature of Quantity is *Divisibility*; and considering that rare things are more divisible then dense ones; we must needs acknowledge, that the nature of Quantity is some way more perfectly in things that are Rare, then in those that are Dense. On the other side, more compacted and dense things may haply seem to some to have more Quantity then those that are rare; and that is but shrunk together, which may be stretch'd out and driven into much greater dimensions then the Quantity of rare things, taking the quantities of each equal in outward appearance. As gold may be beaten into much more and thinner leaf, then an equal bulk of silver or lead. A wax candle will burn longer with a small light, then a tallow candle of the same bigness; and consequently, be converted into a greater quantity of fire and air. Oyl will make much more flame then spirit of wine, that is far rarer then it.

These and such like considerations have much perplex'd Philosophers, and driven them into diverse thoughts to find out the reasons of them. Some, observing that the dividing of a body into little parts makes it less apt to descend, then when it is in greater, have believ'd the whole cause of lightness and rarity to be derived from division. As for example, they

B 3

find

4.  
The opinion of those Philosophers declared, who put Rarity to consist in an actual division of a Body into little parts.



find that lead cut into little pieces will not go down so fast in water, as when it is in bulk: and it may be reduced into so small atomes, that it will, for some space, swim upon the water like dust of wood.

Which assumption is prov'd by the great *Galileus*: to whose excellent wit and admirable industry the world is beholding, not only for his wonderful discoveries made in the Heavens, but also for his accurate and learned declaring of those very things that lye under our feet. He (about the 90. page of his *first Dialogue of Motion*) clearly demonstrates, how any real *medium* must of necessity resist more the descent of a little piece of lead, or any other weighty matter, than it would a greater piece: and the resistance will be greater and greater, as the pieces are lesser and lesser. So, that as the pieces are made less, they will in the same *medium* sink the slower; and seem to have acquired a new nature of lightness by the diminution: not only of having less weight in them, than they had; as half an ounce is less than a whole ounce; but also of having in themselves a less proportion of weight to their bulk, than they had; as a pound of Cork is, in regard of its magnitude, lighter than a pound of Lead. So as they conclude, that the thing, whose continued parts are the lesser, is in its own nature the lighter and the rarer: and other things, whose continued parts are greater, be heavier and denser.

5.  
The former  
opinion re-  
jected, and the  
ground of  
their error  
discover'd.

But this discourse reaches not home: for, by it, the weight of any body being discovered, by the proportion it has to the *medium*, in which it descends, it must ever suppose a body lighter than it self, in which it may sink and go to the bottome. Now, of that lighter body, I enquire, what makes it be so; and you must answer, by what you have concluded, that it is lighter than the other, because the parts of it are lesse and more severd from one another: for, if they be as close together, their division avails them nothing; since things sticking fast together work as if they were but one, and so a pound of lead, though it be filed into small dust, if it be compacted hard together, will sink as fast as if it were one bulk.

Now then, allowing the little parts to be seperated, I ask, what other body fills up the spaces, between those little parts of the *medium* in which your heavy body descends? For, if  
the



the parts of water are more sever'd then the parts of lead, there must be some other substance to keep the parts of it asunder, let us suppose this to be air : and I ask, Whether an equal part of air be as heavy as so much water ; or whether it be not ? If you say it is ; then the compound of water and air must be as heavy as lead ; since their parts one with another are as much compacted as the parts of lead are. For, there is no difference whether those bodies, whose little parts are compacted together, be of the same substance or of divers, or whether the one be divided into smaller parts then the other or not ( so they be of equal weights ) ; in regard of making the whole equally heavy : as you may experience, if you mingle pin-dust with a sand of equal weight, though it be beaten into far smaller divisions then the pin-dust, and put them in a bag together.

But if you say, that air is not so heavy as water ; it must be, because every part of air hath again its parts more sever'd by some other body, then the parts of water are sever'd by air : And then, I make the same instance, of that body which severs the parts of air. And so at last ( since there cannot actually be an infinite process of bodies, one lighter then another ), you must come to one, whose little parts, filling the pores and spaces between the parts of the others, have no spaces in themselves to be fill'd up.

But, as soon as you acknowledge such a body to be lighter and rarer then all the rest, you contradict and destroy all you said before : For, by reason of its having no pores, it follows by your rule that, the little parts of it must be as heavy, if not heavier, then the little parts of the same bigness of that body whose pores it fills ; and consequently, it is proved, by the experience we alledg'd of pin-dust mingled with sand, that the little parts of it cannot, by their mingling with the parts of the body in which it is immediately contain'd, make that lighter then it would be if these little parts were not mingled with it. Nor would both their parts mingled with the body which immediately contains them, make that body lighter. And so, proceeding on in the same sort through all the mingled bodies till you come to the last that is immediately mingled with water ; you will make water nothing the lighter for being mingled with all these : and, by consequence, it should be as heavy and as dense as lead.



Now, that which deceiv'd the Authors of this opinion was, that they had not a right intelligence of the causes, which made little parts of bodies (naturally heavie) descend slowly, in regard of the velocity of greater parts of the same bodies descending: the Doctrine of which we intend to deliver hereafter.

6  
The opinion  
of those Phi-  
losophers re-  
lated, who put  
Rarity to con-  
sist in the mix-  
tion of *Vacuity*  
among bo-  
dies.

Others therefore, perceiving this rule to fall short, have endeavour'd to piece it out by the mixtion of *Vacuitie* among bodies; believing, it is that which makes one rarer then another. Which mixtion they do not put always immediate to the main body they consider: but, if it have other rarer and lighter bodies mingled with it, they conceive this mixtion immediate only to the rarest or lightest. As for example, a Crystal being lighter, and consequently rarer, then a Diamond, they will not say there is more vacuity in a Crystal then in a Diamond; but that the pores of a Crystal are greater, and consequently there is more aire in a Crystal to fill the pores of it, then is in a Diamond: and the vacuities are in the aire, which abounding in a Crystal more then in a Diamond, makes that lighter and rarer then this, by the more vacuities that are in the greater Quantity of aire which is mingled with it.

But, against this supposition, a powerful adversary is urged: for *Aristotle* (in his 4. Book of *Physicks*) hath demonstrated that there can be no motion in vacuity. 'Tis true, they endeavour to evade his demonstration (as not reaching home to their supposition,) by acknowledging it to be an evident one in such a vacuity as he there speaks of; which he supposed so great, that a body may swim in it as in an Ocean, and not touch or be near any other body; whereas, this opinion exclude all such vast inanity, & admit no vacuities but so little ones, as no body whatever can come to, but will be bigger than they, and, consequently, must on some side or other touch the corporal parts which those vacuities divide; for they are the separations of the least parts that are, or can be, actually divided from one another: which parts must of necessity touch one another, on some side, or else they could not hang together to compose one substance; and and therefore the dividing vacuities must be less then the divided parts. And thus, no body will ever be in danger of floating up and down without touching any thing: which is the difficulty that *Aristotle* chiefly impugns.



I confess I should be very glad that this supposition might serve our turne, and save the *Phænomena*, that appear among bodies, through their variety of Rarity and Density. Which if it might be, then would I straight go on to the inquiring after what follow'd out of this ground; as Astronomers (to use our former similitude) calculate the future appearances of the Celestial bodies out of those motions and orbs they assign to the Heavens. For, as this apprehension of vacuity in bodies is very easie and intelligible; so the other (which I conceive to be the truth of the case) is exceedingly abstracted, and one of the most difficult points in all the *Metaphysicks*: and therefore I would (if it were possible) avoid touching upon it in this discourse, which I desire should be as plain and easie, and as much removed from, Scholastick terms, as may be.

But indeed, the inconveniences that follow out of this supposition of vacuities are so great, as it is impossible by any means to slide them over. As for example; let us borrow of *Gallileus* the proportion of weight between water and air. He shews us how the one is 400 times heavier then the other. And *Marinus Ghetaldus* teaches us that gold is 19 times heavier then water: so that gold must be 7600 times heavier then air. Now then, considering that nothing in a body can weigh, but the solid parts of it, it follows, that the proportion of the parts of gold, in a sphere of an inch *Diameter*, is, to the parts of the air of a like dimension, as 7600 is to one. Therefore, in air it self, the vacuities that are supposed in it will be, to the solid parts of it, in the same proportion as 7600 to one. Indeed, the proportion of difference shal be greater: for, even in gold many vacuities must be admitted; as appears by the heating of it, which shews that in every least part it is exceeding porous. But, according to this rate, without pressing the inconvenience any further, the air will, by this reckoning, appear to be like a net, whose holes & distances are to the lines and threds in the proportion of 7600 to one: and, so, would be lyable to have little parts of its body swim in those greater vacuities; contrary to what they strive to avoid. Which would be exceedingly more, if we found, on the one side, any bodies heavier & denser then gold, & that were so solid as to exclude all vacuities; & on the other side, should balance them with such

The opinion of  
Vacuities refu-  
ted.

Dialog. R. del.  
*Movim.* pag. 18.

Archimed.  
promot.

bodies



bodies as are lighter and rarer then air, as fire is, and as some say will have the æther to be. But, already the disproportion is so great and the vacuity so strangely exceeds the body in which it is, as were too great an absurdity to be admitted.

And besides it would destroy all motion of small bodies in the air; if it be true (as *Aristotle* hath demonstrated, in the fourth Book of his *Physicks*) that motion cannot be made but among bodies, and not in *vacuo*.

Again, if rarity were made by vacuity, rare bodies could not be gather'd together, without losing their rarity and becoming dense. The contrary of which, we learn by constant experience: as when the Smith and Glasse-mender drive their white and *fury* fires, (as they term them); when aire pierces most in the sharp wind: and generally we see that more of the same kind of rare bodies, in less place, works more efficaciously, according to the nature that results out of that degree of rarity. Which argues, that every little part is as rare as it was before (for else it would lose the vertue of working according to the nature); but that, by their being crowded together, they exclude all other bodies that before mediated between the little parts of their main body; and so, more parts being gotten together, in the same place then formerly there were, they work more forcibly.

Thirdly, if such vacuities were the cause of rarity, it would follow that fluid bodies, being rarer then solid ones, would be of themselves standing, like nets or cobwebs: whereas contrariwise, we see their natures are to run together, and to fill up every little creek and corner; which effect, following out of the very nature of the things themselves, needs must exclude vacuities out of that nature.

And lastly, if it be true (as we have shew'd in the last Chapter) that *there are no actual parts in Quantity*; it follows of necessity, that all Quantity must of it self be one; as *Metaphysicks* teach us: and then, no distance can be admitted between one Quantity and another.

And truly, if I understand *Aristotle* right, he hath perfectly demonstrated, that no vacuity is possible in nature; neither great nor little: and consequently, the whole machine, raised upon that supposition, must be ruinous. His argument is to this purpose;



purpose : What is nothing cannot have parts : but *vacuum* is nothing, ( because, as the Adversaries conceive it, *vacuum* is the want of a corporeal substance in an inclosing body ; within whose sides nothing is, whereas a certain body might be contain'd within them ; as if, in a pail or bowl of a gallon, there were neither milk, nor water, nor air, nor any other body, whatever ) : therefore *vacuum* cannot have parts. Yet those who admit it put it expressly for a Space ; which essentially includes Parts : and thus they put two contradictories, nothing and parts, that is parts and no parts ; or something and nothing in the same proposition. And this I conceive to be absolutely unavoidable.

For these reasons therefore, I must entreat my Readers favour, that he will allow me to touch upon *Metaphysicks*, a little more than I desire or intended : but it shall be no otherwise, then as is said of the Dogs by the River *Nilus* side ; who being thirsty lap hastily of the water, only to serve their necessity, as they run along the shore. Thus then remembering how we determin'd that Quantity is *Divisibility*, it follows, that, if besides Quantity there be a Substance or Thing, which is divisible, that Thing if it be condistinguish'd from its Quantity or *Divisibility*, must of it self be indivisible ; or ( to speak more properly ) it must be not divisible. Put then such Substance to be capable of the Quantity of the whole world or Universe ; and consequently, you put it of it self indifferent to all, and to any part of Quantity : for in it, by reason of the negation of *Divisibility*, there is no variety of parts, wherof one should be the subject of one part of Quantity, or another of another ; or that one should be a capacity of more, another of less.

This then being so, we have the ground of more or less Proportion between Substance and Quantity : for, if the whole Quantity of the Universe be put into it, the proportion of Quantity to the capacity of that substance, will be greater, than if but half that quantity were imbibed in the same substance. And, because proportion changes on both sides, by the single change of only one side : it follows, that in the latter, the proportion of that Substance to its Quantity is greater ; and that in the former, 'tis less, though the Substance in it self be indivisible.

What.

8.

Rarity and Density consist in the severall proportions, which Quantity hath to its Substance.



What we have said thus in abstract will sink more easily into us, if we apply it to some particular bodies here among us, in which we see a difference of Rarity and Density; as to air, water, gold, or the like: and examine if the effects, that happen to them, do follow out of this disproportion between substance and Quantity. For example, let us conceive that all the quantity of the world were in one uniform substance; then the whole universe would be of one and the same degree of Rarity and Density: let that degree be the degree of water; it will then follow that, in what part soever there happens to be a change from this degree, that part will not have that proportion of quantity to its substance, which the quantity of the whole world had to the presupposed uniform substance. But, if it happens to have the degree of rarity which is in the air; it will then have more quantity in proportion to its substance, then would be due to it according to the presupposed proportion of the quantity of the universe to the aforesaid uniform substance: which in this case is as it were the standard to try all other proportions by. And contrariwise, if it happens to have the degree of Density which is found in earth or in gold; then it will have less quantity in proportion to its substance, then would be due to it according to the aforesaid proportion, or common standard.

Now to proceed from hence, with examining the effects which result out of this compounding of Quantity with substance; we may first consider, that the Definitions, which *Aristotle* has given us of *Rarity* and *Density*, are the same we drive at. He tells us, that that body is *rare* whose quantity is more, and its substance less; that contrariwise, *dense*, where the substance is more and the quantity less. Now, if we look into the proprieties of the bodies we have named, or of any others; we shall see them all follow clearly out of these definitions. For first, that one is more diffused, another more compacted; such diffusion and compaction seem to be the very natures of *Rarity* and *Density*, supposing them to be such as we have defined them to be; since substance is more diffused by having more parts, or by being in more parts; and is more compacted, by the contrary. And then, that rare bodies are more divisible than dense ones, you see is coincident into the same conceit with their diffusion and compaction. And from hence again it follows



lows, that they are more easily both divided into great, and, by the force of natural Agents, divisible into lesser parts: for both these (that is, facility of being divided, and easie divisibility into lesser parts) are contain'd in being more divisible; or in more enjoying the effect of Quantity, which is divisibility. From this again follows, that in rare bodies there is less resistance to the motion of another body through it, than in dense ones; and therefore a like force passes more easily through the one, than through the other. Again, rare bodies are more penetrative and active than dense ones: because being (by their overproportion of quantity) easily divisible into small parts, they can run into every little pore, and so incorporate themselves better into other bodies, than more dense ones can. Light bodies likewise must be rarer, because most divisible, if other circumstances concur equally.

Thus you see decypher'd to your hand the first division of bodies, flowing from Quantity as it is ordain'd to Substance for the composition of a Body: for, since the definition of a Body is a thing which hath parts, and quantity is that by which it hath parts, and the first propriety of quantity is to be bigger or lesse, and consequently the first differences of having parts are to have bigger or lesse, more or fewer; what division of a Body can be more simple, more plain, or more immediate, than to divide it by its Quantity, as making it have bigger or less, more or fewer parts, in proportion to its Substance?

Neither can I justly be blamed for touching thus on *Metaphysicks*, to explicate the nature of these two kinds of Bodies: for, *Metaphysicks* being the Science above *Physicks*, it belongs to her to declare the principles of *Physicks*; of which these we have now in hand are the very first step. But much more, if we consider that the composition of quantity with substance is purely *Metaphysical*, we must necessarily allow the inquiry into the nature of *Rarity* and *Density*, to be wholly *Metaphysical*; since the essence of *Rarity* and *Density* stands in the proportion of quantity to substance: if we believe *Aristotle*, (the greatest master that ever was, of finding out definitions and notions), and trust to the uncontrollable reasons we have brought in the precedent discourse.

This explication of *Rarity* and *Density*, by the composition  
of



All must admit, in Physical bodies, a Metaphysical composition.

of substance with quantity, may peradventure give little satisfaction to such as are not used to raise their thoughts above Physical and natural speculations; who are apt to conceive there it no other composition or resolution, but such as our senses shew us in compounding and dividing bodies according to quantitative parts. Now, this obliges us to shew, that such a kind of composition and division as this must necessarily be allow'd of, even in that course of doctrine which seems most contrary to ours. To which purpose, let us suppose that the position of *Democritus* or of *Epicurus* is true; to wit, that the original compositions of all bodies is out of very little ones of various figures, all of them indivisible, not Mathematically, but Physically: and, that this infinite number of indivisibles floats in an immense ocean of *vacuum* or imaginary space. In this position, let any man, who conceives their grounds may be maintained, explicate, how one of these little bodies is moved. For, taking two parts of *vacuum*, in which this body successively is; 'tis clear, that *really*, and not only in my *understanding*, 'tis a difference in the said body, to be now *here* now *there*: wherefore, when the body is gone *thither*, the notion of being *here* is no more in the body; and consequently, is divided from the body. And therefore, when the body was *here*, there was a composition between the *body* and its being *here*; which, seeing it cannot be betwixt two parts of Quantity, must of necessity be such a kind of composition, as we put between quantity and substance. And certainly, let men wrack their brains never so much, they will never be able to shew how motion is made, without some such composition and division; upon what grounds soever they proceed.

And if then they tell us, that they understand not how there can be a divisibility between substance and quantity; we may reply, that to such a divisibility two things are required: first, that the Notions of Substance and Quantity be different; secondly, that one of them may be Chang'd without the other. As for the First, 'tis most evident, we make an absolute distinction between their two notions: both when we say that *Socrates* was bigger a Man than a Boy; and when we conceive that milk or water while it boyles, or wine while it works, so as they run over the vessels they are in, are greater, and possess



possess more place, then when they were cool and quiet, and fill'd not the vessel to the brim. For, however witty explications may seem to evade, that the Same thing is now greater now lesser; yet it cannot be avoided but that ordinary men, who look not into *Philosophy*, both conceive it to be so, and in their familiar discourse express it so: which they could not do, if they had not different notions, of the Substance and of the Quantity of the thing they speak of. And, though we had no such evidences, the very names and definitions of them would put it beyond strife: all men calling *substance* a Thing; *quantity*, Bigness; and refering a Thing to *Being* (as who would say, that which is) but Bigness, to some other of like nature to which it is compar'd, as, that it is half as big, twice as big, or the like.

This then being unavoidable, that the Notions are distinguish'd; there remains no difficulty but only in the Second, namely, that the one may be Chang'd, and the other not: Which reason and demonstration convince, as we have shew'd. Wherefore, if any shall yet further reply, that they do not understand *how* such change is made; we shall answer, by asking them whether they know how the change of being sometimes *here* sometimes *there* is made by local motion in *vacuum*, without a change in the body moved. Which question if they cannot satisfie, they must either deny that there is any local motion in *vacuum*; or else admit a change in quantity without a change in substance: for this latter is as evidently true, as they suppose the former to be; though the manner how they are effected be alike obscure in both, and the reason of the obscurity the same in both.

With which we will conclude the present Chapter; adding onely this note: That, if all Physical things and natural changes proceed out of the constitution of rare and dense bodies, in this manner as we put them, (which the work we have in hand intends to shew); then, so manifold effects will so convince the truth of this doctrine we have declared, that there can remain no doubt of it: nor can there be any, of the divisibility of quantity from substance, without which this doctrine cannot consist. For, it cannot be understood, how there is a greater proportion of quantity than of substance;



*non probatur,  
ut videtur.*

stance, or contrariwise, of substance then of quantity, if there be not a real divisibility between quantity and substance. And much less can it be conceiv'd, that the same thing hath at one time a greater proportion of Quantity, and at another time a less; if the greater or lesser proportion be not separable from it, that is, if there be not a divisibility betwixt it and substance, as well as there are different notions of them. Which to prove, by the proper principle belonging to this matter, would require us to make a greater inroad into the very bowels of *Metaphysics*, and to take a larger circuit, then is fitting either for the subject, or for the intended brevity of this Treatise.

#### CHAP. IV.

*Of the four first Qualities: and of the four Elements.*

I.  
The notions of density and rarity have a latitude capable of infinite variety.

**T**He subject of our discourse hitherto hath been three simple notions, *Quantity*, *Rarity*, and *Density*. Now it shall be to enquire, if, by compounding these with *Gravity* or *Weight* (which is one of the *specieses* of Quantity above mentioned, and of which I shall speak at large hereafter) we may beget any further qualities, and so produce the *Four first Bodies*, call'd *Elements*. In imitation of *Logicians*, who, by compounding such propositions as of themselves are evident to mans nature as soon as they are proposed, bring forth new knowledges: which threds they still entermix and weave together, till they grow into a fair piece. And thus the Sciences they so much labour for, and that have so great an extent, result out of few and simple notions in their beginnings.

But, before we fall to mingling and comparing them together, I think it will not be amiss to set down and determine, what kind of things we mean by *rare*, and what by *dense*; that, when the names are agreed on, we may slip into no error by mistaking them. So then, though there be several considerations, in regard of which rarity and density may be differently attributed to bodies: yet, because mans discerning them, to be able to discourse accordingly of them, is the principal respect for which their denominations are to be allotted them;

we



we may with reason call those things *dense*, wherein a man finds a *sensible* difficulty to part them, and those *rare*, where the *resistance* is *imperceptible*.

And to these two notions of rarity and density we must allow a great latitude, far from consisting in an indivisible state; for, since rarefaction makes a lesser body equal to a bigger; and all inequality betwixt two bodies, has the conditions of a Body; it follows, that the excess of one body over another consists of infinite parts, into which it might be divided; and, consequently, that what is rarified passes as many degrees, as the inequality or excess hath parts. And the same law being in condensations; both dense and rare things must be acknowledg'd capable of infinite variety and diversity of states, in regard of more and less in the same kind.

These things being premised; and calling to mind that 'tis the nature of density to make the parts of a dense thing compact, and stick together, and be hardly divisible; and, on the contrary side, that 'tis the nature of rarity to diffuse and extend a rare thing, and prepare and approach it to division, according to the proportion of the degree of rarity which it has; and that weight abounds where there is excess of density, and is very little or none in excess of rarity: we may now begin in our imagination to put these Qualities into the scales one against another, to see what effects they produce in Bodies. And first, let us weigh Gravity against Density or sticking together of parts: which sticking or compactedness, being natural to density, requires some excess of gravity in proportion to the density, or some other outward violence, to break it. If then in a dense body the gravity overcome the density, and make the parts of it break asunder; it will draw them downwards towards the *center* that gravity tends to, and never let them rest till they come thither, unless some impediment meet them by the way and stop their journey: so that such a body will, as near as it possibly can, lie in a perfect *spherical* figure in respect of the *center*; and the parts of it will be chang'd and alter'd, and thrust on any side that is the ready way thither, the force of gravity therefore working upon it, it will run as far as it meets with nothing to hinder it from

C

attain-

2.

How moistness  
and dryness  
are begotten  
in dense bodies.



attaining this spherical *superficies*. Wherefore such bodies, for the most part, have no settled outside of their own; but receive their figure and limits from such lets as hinder them from attaining to that sphericalness they aim at.

Now *Aristotle* (whose definitions are in these matters generally receiv'd, as fully expressing the notions of mankind) tells us, and our own experience confirms it, that we use to call those things moist, which run in such sort as we have here set down: and that we term those things dry, which have a Consistence within themselves, and which, to enjoy a determinate figure, do not require the stop or hinderance of another body to limit and circle them in; which will be the nature of those that have a greater proportion of density in respect of their gravity.

And thus, out of the comparison of density with weight, we have found two more qualities then we yet had met withall, namely *wetness* and *dryness*. For, though a body be dense, (which of its own nature, singly considered, would preserve the continuity of its parts, as making the body hardly divisible; whereby it would be *dry*) yet if the gravity that works upon it be, in proportion, greater then the density; it will sever the parts of it, and make them run to the *center*, and so become fluide and moist: though not in the eminentest degree that may be of fluidity and moisture: because that, if the like over proportion of gravity happen in a rare body, it will there more powerfully work its effect, then it can in a dense body; because a rare body will more easily obey and yield to the gravity that masters it, then a dense one will, and consequently, will be more fluide and moist then it.

3.  
How moistness  
and driness  
are begotten  
in rare bodies.

Now on the other side, in weighing Rarity against Gravity, if it happen that the Rarity overcome the Gravity, then the gravity will not change the figure of a body so proportion'd; but what figure it has from its proper natural causes, the same will still remain with it: and consequently, such a body will have *terms of its own*, and not require an ambient body to limit and circle it in; which nature we call *dry*.

But, if the proportion of the gravity be the greater and overcome the rarity, then, by how much the rarity is greater, so much the more will the gravity force it to apply it self equally



ly and on all sides to the *center*; and such a body will the more easily receive its figure from another, and will be less able to consist of it self: which properties, we attribute to wetness or *moisture*. So that it appears, how the qualities of wet and dry, which first we found in things that were dense, are also common to that nature of bodies which we term rare.

And thus, by our first inquiry after what kind of bodies result out of the compounding of rarity and density with gravity, we discover four different sorts: some *dense* ones that are *dry*, and others likewise dense that are *moist*; then again, some *rare* ones that are likewise moist, and other rare ones that are *dry*.

But we must not rest here: let us proceed a little further, to search what other properties these four kinds of bodies will have; which we shall best discover, if we apply them severally to some other compounded bodie (of which nature are all those we converse with or see), and then consider the effects which these work upon it. To begin with that, which we said is so excessively Rare that gravity has no power over it. If we look on the multitude of little parts it may be divided into, whereof every one will subsist by it self (for we have already proved it dry, and then suppose them to be moved with force and strength against the body we apply them to: it must necessarily follow that they will forcibily get into the porousness of it, and pass with violence between part and part, and of necessity separate the parts of that thing one from another; as a knife or wedge doth a solid substance, by having their thinnest parts press'd into it. So that if, in the compounded thing, some parts be more weighty, others more light, (as of necessity there must be); the heaviest will all fall lowest, the lightest will fly uppermost, and those which are of a mean nature between the two extremes will remain in the middle. In summe, by this action an extreme rare body upon a compounded one, all the parts of one kind that were in the compounded one will be gathered into one place; and those of divers kinds into divers places: which is the notion whereby *Aristotle* hath express'd the nature of *heat*; and is an effect which daily experience, in burning and boiling, teaches us to proceed from heat. And therefore we cannot doubt, but such extreme rare bodies are as well hot as dry.

4.  
Heat is a propertie of rare bodies, and cold of dense ones.



On the other side, if a Dense thing be apply'd to a compound, it will (because it is weighty) press it together: and, if that application be continu'd on all sides, so that no part of the body that is pressed be free from the siege of the dense body that presses it, it will form it into a narrower room, and keep in the parts of it, not permitting any of them to slip out: So that what things soever it finds within its power to master, be they light or heavy, or of what contrary nature soever, it compresses them as much as it can, and draws them into a less compass, and holds them strongly together, making them stick fast to one another. Which effect *Aristotle* took for the proper notion of cold; and therefore gave for definition of the nature of it, *that* it gathers things of divers natures: and experience shews us in freezing, and all great coolings, that this effect proceeds from cold.

§.  
Of the two  
dense bodies,  
the less dense  
is more cold:  
but of the two  
rare ones, the  
less rare is  
less hot.

But, if we examine which of the two sorts of dense bodies, the fluide or the consistent, is most efficacious in this operation, we shall find that the less dense one is more capable of being apply'd round about the body it shall besiege; and therefore will stop closer every little hole, and more easily send subtile parts into every little vein of it; and by consequence, shrink it up together and coagulate and constringe it more strongly, then a body can that is extremely dense; which, by reason of its great density and the stubbornness of its parts, cannot so easily bend and ply them to work this effect. And therefore, a body that is immoderately dense is colder then another that is so in excess; since cold is an active or working power, and that which is less dense excels in working.

On the contrary side, rare bodies being hot, because their subtile parts, environing a compounded body, will sink into the pores of it, and, to their power, separate its parts; it follows that those, wherein the gravity overcomes the rarity, are less hot then such others, as are in the extremity and highest excess of rarity: both, because the former are not able to pierce so little parts of the resisting dense body, as extreme rare ones are; and likewise, because they more easily take ply by the obstacle of the solid ones they meet with, then these do.

So



So that out of this discourse we gather, that, of such bodies as differ precisely by the proportion of Rarity and Density, those which are extremely rare are in the excess of heat, and are dry withall: that weighty rare bodies are extremely humid, and meanly hot: that fluide dense bodies are moist, though not in such excess as rare ones that are so; but are coldest of any: and lastly, that extreme dense bodies are less cold than fluide dense ones, and that they are dry.

But, whether the extreme dense bodies be more or less dry, then such as are extremely rare, remains yet to be decided. Which we shall easily do, if we but reflect that it is density which makes a thing hard to be divided, and rarity makes it easie: for, a facility to yeeld to division is nothing else, but a pliability in the thing that is to be divided, whereby it easily receives the figure, which the thing that divides it doth cast it into. Now this pliability belongs more to rare than to dense things: and accordingly, we see fire more easily bend, by the concameration of an oven, then a stone can be reduced into due figure by hewing. And therefore, since dryness is a quality that makes those bodies, wherein it reigns, conserve themselves in their own figure and limits, and resist the receiving of any from another body: it is manifest that those are driest wherein these effects are most seen, which is, in dense bodies: and consequently, excess of dryness must be allotted to them, to keep company with their moderate coldness.

Thus we see that the number of *Elements* assign'd by *Aristotle* is truly and exactly determin'd by him: and that there can be neither more nor less of them; and their qualities are rightly allotted to them. Which to settle more firmly in our minds, it will not be mis-spent time to sum up in short the effect of what we have hitherto said to bring us to this Conclusion. First, we shew'd that a body is made and constituted a Body, by Quantity. Next, that the first division of Bodies is into Rare and Dense ones; as differing only by having more & less Quantity. And lastly, that the conjunction of Gravity with these two breeds two other sorts of combinations; each of which is also twofold: the first sort, concerning Rarity, out of which arises one extremely hot and moderately dry, and another

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The extreme dense body is more dry then the extreme rare one.

7.

There are but four simple bodies: and these are rightly named *Elements*.



other *extremely humid* and *moderately hot*; the second sort, concerning Density, out of which is produced one that is *extremely cold* and *moderately wet*, and another *extremely dry* and *moderately cold*. And these are the combinations whereby are constituted, *Fire, Air, Water, and Earth*.

So that we have thus the proper notions of the *Four Elements*; and both them and their qualities driven up and resolv'd into their most simple Principles: which are the notions of *Quantity*, and of the two most simple differences of quantitative things, *Rarity* and *Density*. Beyond which mans wit cannot penetrate; nor can his wishes aim at more in this particular: seeing he has attain'd to the knowledge of what they are, and of what makes them be so, and that it is impossible they should be otherwise; and this, by the most simple and first principles which enter into the composition of their nature. Out of which it is evident, these Four bodies are *Elements*: since they cannot be resolv'd into any others, by way of physicall composition; themselves being constituted by the most simple Differences of a Body. And again, all other bodies whatever must of necessity be resolv'd into them, for the same reason; because no bodies can be exempt from the First differences of a Body. Since then, we mean by the name of an *Element*, a Body not composed of any former bodies, and of which all other bodies are composed; we may rest satisfied that these are rightly so named.

8  
The Author  
doth not de-  
termine whe-  
ther every  
Element com-  
prehends un-  
der its name  
one only low-  
er species, or  
many: nor  
whether any  
of them be  
sound pure.

But, whether every one of these four Elements, comprehend under its name one only lowest *Species* or many, (as, whether there be one only *Species* of fire, or several; and the like of the rest;) we intend not here to determine. Yet we note, that there is a great latitude in every kind; since *Rarity* and *Density* (as we have said before) are as divisible as *Quantity*. Which Latitudes, in the bodies we converse with, are so limited that, What makes it self and other things be *seen* (as being accompanied by light) is called *Fire*: What admits the illuminative action of fire, and is *not seen*, is called *Air*: What admits the same action, and is *seen* (in the rank of *Elements*) is called *Water*: And what, through the density of it, admits not that action, but *absolutely reflects* it, is called *Earth*.

And, out of all we said of these four Elements, it is mani-  
fest



fest there cannot be a fifth : as is to be seen at large in every *Aristotelian Philosopher* that writes of this matter. I am not ignorant that there are sundry objections used to be made, both against these notions of the First Qualities, and against the division of the Elements : but because they and their solutions are to be found, in every ordinary Philosopher, and not of any great difficulty, and that the handling them is too particular for the design of this discourse, and would make it too prolix ; I refer the Reader to seek them for his satisfaction, in those Authors that treat *Physick* professedly, and have deliver'd a compleat body of *Philosophy*.

And I will end this Chapter with advertising him ( lest I should be misunderstood ) that though my disquisition here has pitch'd on the four bodies of Fire, Air, Water, and Earth; yet it is not my intention to affirme that those which we ordinary call so, and fall daily within our use, are such as I have here express'd them : or that these Philosophicall ones (which arise purely out of the combination of the first qualities) have their residence or consistence in great bulks, in any places of the World, be they never so remote ; as Fire in the hollow of the Moons Orb, Water in the bottom of the Sea, Air above the Clouds, and Earth below the Mines. But, these notions are onely to serve for certain *Idea's* of *Elements* ; by which the forenamed bodies and the compounds of them, may be tryed and receive their doom of more or lesse pure and approaching to the nature from whence they have their denomination. And yet I will not deny, but that such perfect Elements may be found, in some very little quantities ; in mixed bodies ; and the greatest abundance of them, in these four known bodies that we call, in ordinary practise, by the names of the pure ones : for they are least compounded, and approach most to the simpleness of the Elements. But to determine absolutely their existence, or not existence, either in bulk or in little parts, depends of the manner of action among bodies ; which as yet we have not medled with.



## CHAP. V.

*Of the operations of the Elements in general. And of their activities compared with one another.*

I.  
The first operation of the Elements is division, out of which resulteth local motion.

HAVING by our former discourse inquired out, what degrees and proportions of rarity and density compounded with gravity are necessary, for the *production* of the Elements: and first qualities, whose combinations frame the Elements: our next consideration, in that orderly progress we have proposed to our selves in this Treatise, (wherein our aim is to follow successively the steps, which nature has printed out to us), will be to examine the *operations* of the Elements, by which they work upon one another. To which end, let us propose to our selves a rare and a dense body encountring one, another, by the impulse of some exterior agent. In this case, 'tis evident that, since rarity implyes a greater proportion of quantity, and quantity is nothing but divisibility; rare bodies must needs be more divisible then dense ones: and consequently, when two such bodies are press'd one against another, the rare body not being able to resist division so strongly as the dense one is, and being not permitted to retire back, by reason of the external violence impelling it against the dense body; it follows, that the parts of the rare body must be sever'd, to let the dense one come between them; and so the rare body becomes divided, and the dense body the divider. And, by this we see that the notions of *divider* and *divisible*, immediately follow rare and dense bodies; and so much the more properly agree to them, as they exceed in the qualities of Rarity and Density.

Likewise, we are to observe in our case, that the dense or dividing body must necessarily cut and enter further and further into the rare or divided body; and so, the sides of it be joyn'd successively to new and new parts of the rare body. that gives way to it, and forsake others it parts from. Now, the rare body being in a determinate situation of the Universe, (which we call being in a place, and is a necessary condition belonging to all particular bodies); and the dense body coming to be within the rare body, whereas formerly it was not so: it follows, that it loses the place it had, and gains another. This effect, is that which we call *local motion*.

And



And thus we see, by explicating the manner of this action, that *locall motion* is nothing else but *the change of that respect or relation, which the body moved has to the rest of the Universe, following out of Division*: and the name of Locall Motion, formerly signifies only the mutation of a respect to other extrinsecall bodies, subsequent to that division. And this is so evident and agreeable to the notions that all mankind (who, as we have said, is judge and master of language) naturally frames of *place*, as, I wonder, much why any will labour to give other artificall and intricate doctrine of this that in it self is so plain and clear. What need is there to introduce an imaginary space (or, with *Johannes Grammaticus*, a subsistent quantity) that must run through all the World; and then entail to every body an airy entity, an unconceivable mood, an unintelligible *Ubi*, that, by an intrinsecall relation to such a part of the *imaginary space*, must thereto pin and fasten the body it is in? It must needs be a ruinous Philosophy that is grounded upon such a contradiction, as is the allotting of parts to that, which the Authors themselves (upon the matter) acknowledge to be merely nothing; and upon so weak a shift (to deliver them from the inconveniences that, in their course of doctrine, other circumstances bring them to) as is the voluntary creating of new imaginary *Entities* in things, without any ground in nature for them. Learned men should express the advantage and subtilty of their wits, by penetrating further into nature than the vulgar; not by vexing and wresting it from its own course. They should refine and carry higher, not contradict and destroy, the notions of mankind, in those things it is the competent judge of; as it undoubtedly is of those primary notions which *Aristotle* has rank'd under Ten Heads: which (as we have touched before) every one can conceive in gross; and the work of Scholars is to explicate them in particular, and not to make the Vulgar believe they are mistaken in framing those apprehensions that nature taught them.

Out of that which hath been hitherto resolv'd 'tis manifest that *Place* really, (and abstracting from the operation of the understanding), is nothing else but *the inward superficies of a body that compasses and immediately contains another*. Which ordina-

What place is,  
both notional-  
ly and really.



ordinarily, being of a rare body that doth not shew it self to us (namely, the Air), is for the most part unknown by us. But, because nothing can make impression on our minds and cause us to give it a name, otherwise then by being known: therefore our understanding, to make a compleat notion, must add something else to this fleeting and unremarkable *Superficies*, that may bring it to our acquaintance. And, for this end, we may consider further; that, as this *Superficies* hath in it self, so the bodie enclosed in it gains a certain determinate respect to the stable and immoveable bodies that environ it. As for example, we understand such a Tree to be in such a place, by having such and such respects to such a Hill near it, or to such a House that stands by it, or to such a River that runs under it, or, to such an immoveable point of the Heaven that, from the Suns rising in the *Equinox*, is called East, and such like. To which purpose, it imports not whether these, that we call immoveable bodies and points, be truly so, or do but seem so to mankind. For, man talking of things according to the notions he frames of them in his mind (speech being nothing else but an expression to another man, of the images he hath within himself; and his notions being made according to the seeming of the things, he must needs make the same notions, whether the things be truly so in themselves, or but seem to be so; when that seeming or appearance is always constantly the same.

3.  
Locall motion  
is that divi-  
sion, whereby a  
body changes  
its place.

Now then, when one body, dividing another, gets a new immediate clothing; and consequently new respects to the stable and immoveable bodies (or seeming such) that environ it; we vary in our selves the notion we first had of that thing; conceiving it now accompanied with other circumstances and other respects then formerly it had. Which notion we express by saying, it has changed its place, and is now no longer where it was at the first. And this change of place we call Locall motion: to wit, *the departing of a body from that hollow superficies which inclosed it, and its changing to another*; wherby it gains new respects to those parts of the World that have, or in some sort may seem to have, immobility and fixed stableness: So as hence 'tis evident that the substance of Locall motion consists in Division; and that the alteration of Locality follows Division; in such sort as the becoming like or unlike of one wall



wall to another follows the action whereby one of them becomes white.

And therefore, in Nature, we are to seek for any *entity* or special cause of applying the moved body to a place, as *place*, (which is but a *respect* consequent to the effect of division), but only to consider, what real and physical action unites it to that other body, which is called its place, and truly serves for that effect. And consequently, they who think they have discover'd a notable subtilty, by bringing in an *Entity* to unite a Body to its Place, have strain'd beyond their strength, and grasped but a shadow. Which will appear yet more evident, if they but mark well, how nothing is divisible but what of it self (abstracting from division) is one. For the nature of Division is the making of many; which implies, that what is to be divided must of necessity be *not*-many, before it be divided. Now Quantity being the subject of division, 'tis evident that, purely of it self and without any force or adjoyned helps, it must needs be one, wherever some outward agent doth not introduce multiplicity upon it. And, whenever other things work upon quantity as quantity, it is not the nature and power of their operation to produce unity in it and make it *one*; for it is already one: but contrariwise, the immediate necessary effect that flows from them in this case is, to make one quantity *many*; according to the circumstances that accompany the divider and that which is to be divided. And therefore, although we may seek causes, why some one thing sticks *faster* together, than some other; yet to ask absolutely why a body sticks together were prejudicial to the nature of quantity: whose essence is to have parts sticking together; or rather to have such unity, as without which all divisibility must be excluded.

<sup>4.</sup> The nature of quantity of it self is sufficient to unite a body to its place.

Out of which discourse it follows, that, in local motion, we are to look onely for a cause or power to divide, but not for any to unite. For, the very nature of quantity unites any two parts that are indistant from one another, without needing any other cement to glue them together: as we see the parts of water and all liquid substances presently unite themselves to other parts of like bodies, when they meet with them, and to solid bodies if they chance to be next them. And therefore 'tis vain to trouble our heads with Unions and imagina-

ry



ry Moods to unite a body to the place it is in ; when their own nature makes them one as soon as they are immediate to each other. And accordingly, if, when we see a Boul move, we would examine the causes of that motion, we must consider the quantity of air or water it makes to break from the parts next to it, to give place to it self: and not speculate upon an intrinsicall relation from the body to a certain part of the imaginary space, they will have to run through all things. And, by ballancing that quantity of air or water which it divides, we may arrive to make an estimate of what force the Boul needs to have for its motion.

5.  
All operations  
amongst bodies,  
are either local  
motion or such as  
follow out of local  
motion.

Thus having declar'd that the locality of motion is but an extrinsicall denomination and no reality in the thing moved ; we may now cast an eye upon a vast consequence that may be deduced out of what we have hitherto said. For, if we consider the nature of a Body, that is, that a Body is a Body by quantity ; and that the formall notion of Quantity is nothing else but Divisibility ; and that the adequate Act of Divisibility is Division, 'tis evident there can be no other Operation upon Quantity, nor (by consequence) among Bodies, but must either be such Division as we have here explicated, or what must necessarily follow out of such division. And Division (as we have even now explicated) being Local Motion, 'tis evident, that All operations among Bodies are either, Local Motion, or such as follow out of Local motion. Which conclusion, however unexpected and at first hearing appearing a Paradox, will nevertheless by the ensuing work receive such evidence as it cannot be doubted of ; and that, not only by force of argumentation and by necessity of notions, (as is already reduced), but also by experience and declarations of particulars, as they shall occur.

6.  
Earth compared to water  
in activity.

But now, to apply what we have said to our proposed subject : 'tis obvious to every man, that, seeing the Divider is the agent in division and in Local motion ; and dense bodies are by their nature dividers ; the Earth must in that regard be the most active among the Elements, since it is the most dense of them all. But this seems to be against the Common judgment of all the searchers of nature, who unanimously agree that Fire is the most active Element: As also it seems to impugne what we  
our



our selves have determin'd, when we said there were two active qualities, heat and cold; whereof the first was in its greatest excess in Fire, and the latter in water.

To reconcile these, we are to consider, that the action of Cold in its greatest height is composed of two parts; the one is a kind of pressing, and the other is penetration which requires applicability. Of which two the former arises out of density, but the latter out of moderation of density, as I have declared in the precedent Chapter. Wherefore the former will exceed more in Earth, though the whole be more eminent in Water. For though, considering only the force of moving (which is a more simple and abstracted notion, then the determination and particularization of the Elements, and is precedent to it) therein Earth hath a precedency over water: yet, taking the action, as it is determin'd to be the action of a particular Element, and as it concurs to the composition or dissolution of mixed bodies; in that consideration (which is the chief work of Elements, and requires an intime application of the Agents) Water hath the principality and excess over Earth. S. 6.

As for Fire, it is more active then either of them: as will appear clearly, if we consider how, when Fire is applyed to fewel, and the violence of blowing is added to its own motion, it incorporates it self with the fewel, and in a small time converts a great part of it into its own nature, and shatters the rest into smoak and ashes. All which proceeds from the exceeding smallness and dryness of the parts of fire; which being moved with violence against the fewel and thronging in multitudes upon it, easily pierce the porous substance of it, like so many extreme sharp Needles. 7.  
The manner whereby fire gets into fewel, proves that it exceeds earth in activity.

And, that the force of Fire is as great and greater then of Earth, we may gather out of our former discourse; where, having resolved that density is the virtue by which a body is moved and cuts the *medium*, and again considering that celerity of motion is a kind of density (as we shall by and by declare) 'tis evident that, since blowing must of necessity press violently and with a rapid motion the parts of fire against the fewel, and so condense them exceedingly there, (both by their celerity, & by bringing very many parts together there,) it must needs



needs also give them activity and vertue to pierce the body they are beaten against.

New, that Celerity is a kind of Density, will appear, by comparing their natures. For if we consider that a dense body may be dilated so, as to possess and fill the place of a rare body that exceeded it in bigness, and, by that dilatation, may be divided into as many and as great parts as the rare body was divisible into; we may conceive that the substance of those parts was, by a secret power of nature, folded up in that little extension in which it was before. And even so, if we reflect upon two Rivers of equal channels and depths, whereof the one goes swifter then the other; and determine a certain length of each channel, and a common measure of Time: we shall see that, in the same measure of time, there passes a greater bulk of water in the designed part of the channel of the swifter stream, then in the designed part of the slower, though those parts be equal.

Nor imports it that in Velocity we take a part of time, whereas in Density it seems that an instant is sufficient; and, consequently, there would be no proportion between them. For, knowing Philosophers all agree that there are no Instants in time; and that the apprehension of them proceeds meerly from the manner of our understanding: And, as for parts in time, there cannot be assumed any so little, in which the comparison is not true; and so, in this regard, it is absolutely good.

And, if the Reader have difficulty at the disparity of the things which are pressed together, in Density and in Celerity; for that in Density, there is only Substance, & in Celerity there is also Quantity crowded up with the substance; he will soon receive satisfaction, when he shall consider that this disparity is to the advantage of what we say, and makes the nature of density more perfect in celerity; and consequently more powerful in fire then in earth. Besides, if there were no disparity, it would be a distinct *species* of density, but the very same.

By what we have spoken above, it appears how fire gets into fewel; now let us consider how it comes out: for the activity of that fierce body will not let it lie still and rest, as long as it has so many enemies round about it to rouse it up. We see then that, as soon as it has incorporated it self with the fewel

8.  
The same is  
proved by the  
manner, where-  
by fire comes  
out of fewel  
and works  
upon other  
bodies



fewel and is grown master of it, by introducing into it so many of its own parts, like so many Souldiers into an Enemies Town); they break out again on every side with as much violence as they came in. For, by reason of the former resistance of the fewel, their continual streaming of new parts upon it, and one overtaking another there where their journey was stop'd (all which is increas'd by the blowing) doth so exceedingly condense them into a narrower room then their nature effects, that, as soon as they get liberty and grow masters of the fewel (which at the first was their prison), they enlarge their place, and consequently come out and flie abroad; ever aiming right forwards from the point where they begin their journey: for, the violence wherewith they seek to extend themselves into a larger room, when they have liberty to do so, will admit no motion but the shortest, which is by a straight line.

So that if, in our phantasie, we frame an image of a round body all of fire; we must withall presently conceive, that the flame proceeding from it would diffuse it self every way indifferently in straight lines, so that, the source serving for the Center, there would be round about it an huge Sphere and of fire and light; unless some accidental and extern cause should determine its motion more to one part then to another. Which compass, because it is round and has the figure of a Sphere, is by Philosophers term'd *the Sphere of its activity*.

So that it is evident, the most simple and primary motion of fire is a flux in a direct line from the center of it to its circumference, taking the fewel for its center: as also that, when 'tis beaten against a harder body, it may be able to destroy it; though that body be in its own nature more dense then fire. For the body against which it presses either has pores, or has none (as, the Elements have none: ) if it has pores, then the fire, by reason of the violent motion of the impellent, drives out the little bodies which fill up those pores, & succeeding in their room, and being multiply'd there, causes those effects which in our discourse of the Elements we assign'd to heat. But, if it hath no pores, it will be either rare or dense: if it be rare, then, if the force of the impellant be  
greater:



greater than the resistance of the rare body, it will force the fire to divide the rare body. But if it be dense (as, some atome of earth), then, though at the first it cannot divide it, yet, by length of time and continual beating upon it, it may come to wear off some part of it; the force of the impellent by little and little bending the atome of the earth, by driving a continual stream of a lesser part of fire against some determinate part of the atome. By which word, Atome, no body will imagine we intend to express a perfect indivisible; but only the least sort of natural bodies.

## CHAP. VI.

*Of Light : what it is.*

I.  
In what sense  
the Author  
rejects Qua-  
lities.

HAVING said thus much of fire; the near relation between it and Light invites us, in the next place, to bend our eyes, to that which uses to daze theirs who look unwearily upon it. Certainly, as, among all the sensible qualities, it is the principal; so, among all corporeal things, it seems to aim rightest at spiritual nature, and to come nearest it. And by some it has been judg'd to be spiritual; if our eyes be capable to see Spirits. No meaner man then *Aristotle* leads the dance to hold light a quality; and mainly to deny it any bodily subsistence: And there has follow'd him no fewer, then almost all the world ever since. And the question imports no less, then the whole Doctrine of Qualities; for admit light to be a body, and hardly any man will hold up his hand in defence of any other quality; but if it be a quality then all others come in by parity and for company.

But before we go any further, it will not be amiss to express what we mean, when we reject qualities; and how, in some sense, we are content to admit them. According to that description that Philosophers ordinarily make of them, (and especially the Modern) we can by no means give way to them. I confess ingeniously, I understand not what they mean by them; and I am confident, that neither do they. For, the very notion, that their first words seem to express of them, they contradict again, before they make an end of describing what they are. They will have them to be real  
*Entities*



Entities or Things, distinct from the bodies they accompany: and yet; they deny them a subsistence or self-being, saying, they do but inhere in their subject which supports them; or, which is all one, that their being is a dependence on a subject.

If they will reflect upon what they say, and make their thoughts and their words agree, they'll find that the first part of their description makes them compleat substances; which, afterwards, in words they flatly deny: and 'tis impossible to reconcile these two meanings. A reall Entity or Thing must necessarily have an Existence or Being of its own; which they allow them: and, whatever hath so becomes a substance; for it subsists by its own Existence, or (to say plainer,) is what it is by its *own Being*, and needs not the existence of another thing to give it a Being. And then presently to say that it doth not subsist of it self, or that it requires the subsistence of a substance to make it Be, is a pure contradiction to the former.

This arises from a wrong notion they make to themselves of substance, existence, and subsistence: and from their not consulting sufficiently with their own thoughts, as well as studying in Books. They meet there with different terms; by help of which they keep themselves from contradiction in words, but not in effect. If the terms were rightly conceived and notions duely fitted to them, (which requires deep meditation on the things themselves, and a brain free from all inclination to siding, or affection to opinions for the Authors sakes, before they be well understood and examin'd) many of those disputes would fall to the ground; in which oftentimes both sides lose themselves and the question, before they come to an end. They are in the dark before they are aware: and then they make a noyse, only with terms; which, like too heaveie weapons that they cannot weild, carry their strokes beyond their aim. Of such nature are the Qualities and Moods, that some modern Philosophers have so subtilised on. And, in that sense, we utterly denie them: which being a question appertaining to *Metaphysicks*, it belongs not to our present purpose to ingage ourselves further in it.

But, as they are ordinarily understood in common conversation,



In what sense  
the Author ad-  
mits of qua-  
lities.

sation, we allow them. And our work is but to explicate and shew the particulars in retail, of what men naturally spake in grosse. For that serves their turn, to know what one another means : whereas, it belongs only to a Philosopher, to examine the causes of things. Others are content with the effects : and they speak truly and properly, when they design them. As for example : when they say that fire burns by a quality of heat that it has, or that a Deye is square by the qualitie of a cubicall figure that is in it ; they speak as they should do. But, if others will take occasion upon this, to let their understanding give a Being to these qualities, distinct from the substances in which they conceive them ; there they miss. If we consider the same man hungry, or thirsty, or weary, or sleepy, or standing, or sitting ; the understanding presently makes within it self reall things of sleep, hunger, thirst, weariness, standing, and sitting : Whereas indeed, they are but different affections or situations of the same body. And therefore we must beware of applying these notions of our mind, to the things as they are in themselves : as much as we must, of conceiving those parts to be actually in Continued Quantity, wherof we can frame actually distinct notions in our understanding. But as, when ordinary men say, that a Yard contains three feet ; 'tis true, in this sence, that three feet may be made of it, but, whiles 'tis a yard, 'tis but one quantitie or thing, and not three things : so they, who make profession to examine rigourously the meaning of words, must explicate in what sence it is true that Heat and Figure (our former examples) are qualities ; for such we grant them to be, and in no wise contradict the common manner of speech, which enters not into the Philosophicall nature of them.

We say then, that Qualities are nothing else but the Proprieties, or Particularities, wherin one thing differs from another. And therefore *Logicians* call substantiall Differences, substantiall Qualities ; and say, they are predicated in *Quale quid*. But, the Predicament of Quality is orderd, by *Aristotle*, to conclude in it those differences of things, which are neither Substantiall nor quantitative, and yet are intrinsecall and absolute. And so, that which the understanding calls *heat*, and makes a  
notion



notion of (distinct from the notion of the fire from whence it issues to burn the wood that is near it) is nothing else, in the fire, but the very substance of it in such a degree of rarity; or a continual stream of parts, issuing out of the main stock of the same fire, that enters into the wood, and by its rarity makes its way through every little part, and divides them. All which actions are comprised by the understanding, under one notion of *burning*; and the power, (which is *fire* it self) to do these actions, under one notion of the quality of *heat*: though burning in effect, and explicated Philosophically, be nothing else but the continuance of those material motions we have even now described. In like manner, the cubical figure of a deye is nothing else but the very bodie of the deye it self, limited by other bodies from being extended beyond those dimensions it hath: and so, the quality of figure or squareness, which in common speech is said to be in it, is truly substance it self, under such a consideration as is expressed by that word.

But, to come to our question, on the decision of which depends the fate of all the fictitious Entities which the Schools are term'd Qualities. The chief motives that perswade Light to be one of those may, to my best remembrance, be reduced to five several heads. The first is, that it illuminates the Air in an instant, and therefore cannot be a body: for a body requires succession of time to move in; whereas, this seems to spread it self over the whole Hemisphere in an instant. For, as far as the Sun is distant from us, he no sooner raises his head above our *Horizon*, but his darts are in our face: and generally, no imagination can be framed of any motion it has in its dilatation.

3.  
Five arguments proposed to prove that light is not a body.

The next is, that, whereas no body can admit another into its place without being removed away it self, to leave that room to the advenient one; plain experience shews us daily, that two lights may be in the same place; and the first is so far from going away at the coming of the second, that the bringing in of a second Candle, and setting it near the first, increases the light in the room; which diminishes again, when the second is removed away. And, by the same reason, if light were a body, it should drive away the aire



( which is likewise a body ) wherever it is admitted: for, within the whole sphere of the irradiation of it, there is no point, wherein one may set their eye, but light is found. And therefore, if it were a body, there would be no room for air, in that place which light takes up. And likewise, we see that it penetrates all solid bodies ( and particularly glass ) ; as experience shews, in wood, stone, metals, and any other body whatever, if it be made thin enough.

The third argument why light cannot be a body is, that if it were so, it can be none other but fire; which is the subtlest and most rarified of all bodies whatever. But, if it be fire, then it cannot be without heat; and consequently, a man could not feel cold in a sun-shining day: The contrary of which is apparent all winter long, whose brightest dayes oftentimes prove the coldest; And *Galileus*, with divers others since, did use from the Sun to gather light, in a kind of stone that is found in *Italy*, ( which is therefore by them call'd *la calamita della luce* ), and yet no heat appeared in it. A Glow-worm will give light to read by, but not to warm you any whit at all: And it is said, that Diamonds and carbuncles will shine like fire in the greatest darks; yet no man ever complain'd of being serv'd by them as the foolish *Satyre* was, by kissing a burning coal. On the contrary side; if one consider, how great heats may be made without any light at all; how can one be perswaded that light & heat should be the same thing, or indeed any whit of kin?

The fourth motive, to induce us to believe that light cannot be a body, is the sudden extinction of it; when any solid body comes between the fountain of it, and the place where it sends its beams. What becomes of that great expansion of light that shined all about, when a cloud enterposes it self between the body of the Sun and the streams that come from it? Or when it leaves our *Horizon* to enlighten the other world? His head is no sooner out of our sight, but at the instant all his beams are vanished. If that which fills so vast a room were a body, something would become of it; it would at the least be chang'd to some other substance, and some reliques would be left of it, as when ashes remain of burned bodies; for, nature admits not the annihilation of any thing.

And, in the last place, we may conceive that if light were a body,



dy, it would be shaken by the winds and by the motion of the air; and we should see it quaver in all blustering weather. Therefore summing up all we have said, it seems most improbable, and indeed wholly impossible, that light should be a Body; and consequently it must have his place among Qualities.

But, on the other side; before we apply our selves to answer these objections, let us make a short survey of those inducements, that prevail with us to believe light a body, notwithstanding so forcible oppositions. I admit so far of the third argument, as to allow light to be fire; for indeed it cannot be imagin'd any thing else, all properties agreeing so fully between them: But withal I must adde, that it is not fire in every form, or fire joyn'd with every substance, that expresses it self by light; but it is fire extremely dilated and without mixture of any other grosse body. Let me hold a piece of linen or paper close by the flame of a candle, and, by little and little, remove it further and further off; and methinks my very eyes tell me, that there is upon the paper some part of that which I see in the candle, and that it grows still less and less, as I remove the paper further from it: so that if I would trust my sense, I should believe it as very a body upon the paper, as in the candle; though infeebled, by the laxity of the channel in which it flows.

And this seems to be strengthen'd by the consideration of the adversaries position: for if it were a quality, then, seeing it hath no contrary to destroy or stop it, it should still produce an equal to it self, without end or growing feeble; whenever it meets with a subject capable to entertain it, as air is.

The better to apprehend how much this faint resemblance of flame upon the paper maketh for our purpose, let us turn the leaf; and imagine in our thoughts, after what fashion that fire which is in the flame of a little candle would appear to us, if it were dilated and stretch'd out to the utmost extent that excess of rarity can bring it to. Suppose that so much flame, as would fill a cone of two inches height and half an inch Diameter, should suffer so great an expansion, as to replenish with his light body a large chamber: and then, what can we imagine it would seem to be? How would the continual

4.  
The two first reasons to prove light a body are, the resemblance it hath with fire; and because, if it were a quality, it would always produce an equal to it self.

5.  
The third reason; because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.



tinual driving it into a thinner substance, as it streams in a perpetual flood from the flame, seem to play upon the paper? And then judg whether it be likely to be a body or no; when our discourse suggests to us, that, if it be a body, those very appearances must follow, which our eyes give us evidence are so in effect. If gold, beaten into so airy a thinness, as we see gilders use, remains still Gold, notwithstanding the wonderful expansion of it: why shall we not allow, that fire, dilated to its utmost period, shall still remain fire; though extremely rarified beyond what it was?

6.  
The fourth  
reason, from  
the manner of  
the generation  
and corruption  
of light;  
which agrees  
with fire.

We know that fire is the rarest and the subtlest substance that nature hath made among bodies; and we know likewise, that it is ingendred by the destroying and feeding upon some other more grosse body: let us then calculate, when the oyl, or tallow, or wax of a candle, or the bulk of a faggot or billet, is dilated and rarified to the degree of fire; how vast a place must it take up?

To this let us add what *Aristotle* teaches us; that fire is not like a standing pool, which continues full with the same water; and as it has no waste, so has it no supply: but it is a fluent and brook-like current. Which also we may learn, out of the perpetual nutriment it requires: for, a new part of fuel being converted into a new part of fire (as we may observe in the little atomes of Oyl or melted wax, that continually ascend apace up the wicke of a burning candle or lamp; of necessity the former must be gone to make room for the latter; and so a new part of the river is continually flowing.

Now then, this perpetual flux of fire, being made of a grosse body that, so rarified, will take up such a vast room, if it die not at the instant of its birth, but have some time to subsist (be it never so short,) it must needs run some distance from the fountain whence it springs. Which, if it do, you need not wonder, that there should be so great an extent of fire as is requisite to fill all that space which light replenishes; nor that it should be still supplied with new, as fast as the cold of the aire kills it. For, considering that flame is a much grosser substance then grosse fire, by reason of the mixture with it of that viscous oily matter, which, being drawn out of the wood and candle, serves for fuel to the fire and

is



is, by little and little, converted into it; and withal reflecting on the nature and motion of fire, which is, to dilate it self extremely, and to fly all about from the center to the circumference, you cannot choose but conceive that the pure fire, struggling to break away from the oily fewel, which is still turning into new fire, doth at length free his wings from that birdlime; and then flies abroad with extream swiftnes, & swells and dilates it self to a huge bulk, now that it has gotten liberty: and so fills a vast room; but remains still fire till it die. Which it no sooner doth, but it is still supply'd with new streams of it, that are continually strain'd, & as it were, squeel'd out of the thick flame, which imprison'd, and kept it within it; till growing fuller of fire then it could contain (by reason of the continual attenuating the oily parts of it, and converting them into fire), it gives liberty to those parts of fire, that are next the *superficies*, to fly whither their nature will carry them.

And, thus, discourse would inform a Blind man (after he has well reflected on the nature of fire), how it must needs fill a mighty extent of place; though it have but a narrow beginning at its spring head: and that there, by reason of the condensation of it and mixture with a grosser body, it must needs burn other bodies; but that, when it is freed from such mixture and suffers an extream expansion, it cannot have force to burn, but may have means to express it self to be there present, by some operation of it upon some body that is refin'd and subtilized enough to perceive it. And this operation a seeing man will tell you is done upon his eyes: whose fitness to receive impression from so subtile an Agent, *Anatomists* will teach you. And I remember, how a blind Schoolmaster, that I kept in my house to teach my children, (who had extream subtile spirits, and a great tenderness through his whole body; and met with few distractions to hinder him from observing any impression, never so nicely made upon him) used often to tell me, that he felt it very perceptibly in several parts of his body; but especially in his brain.

But, to settle us more firmly in the perswasion of light's being a body, and consequently, fire, let us consider, that the properties of a body are perpetually incident to light: look what rules a ball will keep in its rebounds, the same doth light in

7.  
The fifth reason; because such properties belong to light as agree only to bodies.



its reflections; and the same demonstration alike convinces the one and the other. Besides, light is broken like a body; as, when 'tis snapped in pieces by a tougher body: it is gather'd together in a little room by looking or burning glasses; as water is, by ordering the gutters of a house so as to bring into one cistern all that rains dispers'dly upon the whole roof. It is sever'd and dispers'd, by other glasses; and is to be wrought upon, and cast hither and thither at pleasure: all, by the rule of other bodies. And what is done in light, the same will likewise be done in heat, in cold, in wind, and in sound. And the very same instruments that are made for light, will work their effects in all these others, if they be duly managed.

So that certainly, were it not for the authority of *Aristotle* and his learned followers, that presses us on the one side; and for the seemingness of those reasons we have already mention'd, which perswades us on the other side: our very eyes would carry us by stream into this consent, that light is no other thing but the nature and substance of fire, spread far and wide, and freed from the mixture of all other gross bodies: Which will appear yet more evident, in the solutions of the oppositions we have brought against our own opinion: for, in them there will occur other arguments of no less importance to prove this verity, than these we have already proposed.

## CHAP. VII.

*Two objections answer'd against light being fire; with a more ample proof of its being such.*

I.  
That all light  
is hot and apt  
to heat.

**H**AVING then said thus much to perswade us of the corporeity of this subtile thing, that so quaintly plays with our eyes; we will in the next place examine those objections that, at the beginning, we set down against its being a body: and if, after a through discussion of them, we find they do in truth conclude nothing of what at the first sight they bear so great a shew of, but that we shall be able perfectly to solve and enerve their force; no body will think it rashness in us to crave leave of *Aristotle*, that we may dissent from him in a matter that he has not look'd to the bottom of; and whose opinion therein cannot



cannot be defended from plain contradictions and impossibilities. 'Tis true, never any one man looked so far as he into the bowels of nature; he may be rightly termed the *Genius* of it, and whoever follows his principles in the main cannot be led into error: but we must not believe that he or any man else, who relies upon the strength and negotiation of his own reason, ever had a privilege of infallibility entail'd to all he said. Let us then admire him for what he has deliver'd us: and where he falls short or is weary in his search, and suffers himself to be born down by popular opinions against his own principles (which happens very seldom to him), let us seek to supply and relieve him.

But, to pursue our intent: We will begin with answerin, the third objection; which is, that if light were fire it must heat as well as enlighten, where it shines. There's no doubt but it doth so: as is evident by the weather-glasses, and other artificiall musical instruments (as Organs and Virginals that played by themselves) which *Cornelius Drebbel* (That admirable master of *Mechanicks*) made to shew the King. All which depends upon the rarefaction and condensation of some subtile body, conserv'd in a cavity within the bulk of the whole instrument: for, as soon as the Sun shined, they would have motion and play their parts. And, questionless, that grew out of the rarefaction of the subtile liquor he made use of; which was dilated as soon as the air was warm'd by the Sun-beams: Of whose operation it was so sensible, that they no sooner left the *Horizon*, but its motion ceased; And if but a cloud came between the instrument and them, the musick would presently go slower time. And the ancient miracle of *Memnon's* statue seems to be a juggling of the *Ethiopian* priests, made by the like invention.

But, though he and they found some spirituall and refined matter, that would receive such notable impressions from so small alterations of temper; yet it is no wonder that our gross bodies are not sensible of them: for we cannot feel heat, unless it be greater then that which is in our sense, And the heat there must be in proportion to the heat of our blood; which is an high degree of warmth: and therefore 'tis very possible

2.

The reason why our bodies for the most part do not feel the heat of pure light.



sible, that an exceeding rarified fire, may cause a far lesse impression, of heat then we are able to feel. Consider how, if you set pure spirit of wine on fire, and so convert it into actual flame; yet it will not burn, nor scarce warm your hand: and then can you expect that the light of a candle, which fills a great room, should burn or warm you as far as it shines?

If you would exactly know, what degree of heat and power of burning that light has, which (for example) shines upon the wall in a great chamber, in the midst wherof there stands a candle: do but calculate what overproportion of quantitie all the light in the whole room bears, to the quantity of the little flame at the top of the candle; and that is the overproportion of the force of burning which is in the candle, to the force of burning which is in so much light at the wall as, in extension, is equall to the flame of the candle. Which when you have considered, you will not quarrel at its not warming you at that distance: although you grant it to be fire, streaming out from the flame as from the spring that feeds it, and extremely dilated (according to the nature of fire, when it is at liberty), by going so far without any other grosse body to imprison or clog it.

'Tis manifest, that this rule of examining the proportion of burning in so much of the light as the flame is (by calculating the proportion of the quantity or extension of all the light in the room to the extension of the flame of the candle, and then comparing the flame of the candle to a part of light equall in extension unto it) is a good and infallible one, if we abstract from accidental inequalities: since both the light and the flame are in a perpetual flux; and all the light was first in the flame, which is the spring from whence it continually flows. As in a river, where every part runs with a settled stream; though one place be straighter, and another broader: yet of necessity, since all the water that is in the broad place came out of the narrow, it must follow that, in equal portions of time, there is no more water where it has the liberty of a larg channel, then where the banks press it into a narrow bed; so that there be no inequalities in the bottome.

In like manner, if, in a large stove, a basin of water be converted



verted into steam; that rarified water, which then fills the whole Stove, is no more then what the Basin contain'd before: and consequently, the power of moistening, which is in a foots extension (for example) of the stove wherein that steam is, must be, in proportion to the vertue of wetting in the foot extension of water, as the quantity of that great room, which the steam fills, is to the quantity of the water contain'd in the basin. For, although the rarified water be not in every least part of that great place it seems to take up, by reason that there is Air in which it must swim; yet the power of wetting that was in the Basin of water is dilated through the whole room, by the conjunction of the Myst or Dew to all the sensible parts of the Air that is in the room: and consequently the power of wetting, which is in any foot of that room, is, in a manner, as much less then the power of wetting which was in the foot of water, as if the water were rarified to the quantity of the whole room, and no air were left with it.

And, in the same manner it fares with dilated fire, as it doth with dilated water: with only this difference, peradventure, that Fire grows purer and more towards its own nature, by dilatation: whereas water becomes more mix'd, and is carried from its nature, by suffering the like effect. Yet, dilated water will, in proportion, moisten more then dilated fire will burn, for the rarefaction of water brings it nearer to the nature of air (whose chief propriety is moisture,) and the fire that accompanies it, when it raiseth it into steam, gives it more powerful ingression into what body it meets withal: whereas fire, when 'tis very pure, and at entire liberty to stretch and spread it self as wide as the nature of it will carry it, gets no advantage of burning by its mixture with air; and although it gains force by its purity, yet, by reason of its extreme rarefaction, it must needs be extreamly faint. But if, by the help of Glasses, you will gather into less room what is diffused into a great one, and so condense it as much as it is (for example) in the flame of a candle; then that fire or compacted light will burn much more forcibly then so much flame: for there is as much of it in quantity (excepting what is lost in the carriage of it, and it is held in together in as little room, and it has this advantage besides



besides, that 'tis clog'd with no grosse body to hinder the activity of it.

3.  
The experience of burning glasses, and of soulttry gloomy weather prove light to be fire.

It seems to me now, that the very answering this objection doth (besides repelling the force of it) evidently prove, that light is nothing but fire, in its own nature, and exceedingly dilated: for, if you suppose fire (for example, the flame of a candle) to be stretch'd out to the utmost expansion that you may well imagine such a gross body is capable of; 'tis impossible it should appear and work otherwise then it doth in light, as I have shewd above. And again, we see plainly that light gather'd together burns more forcibly then any other fire whatever, and therefore must needs be fire.

Why then shall we not confidently conclude, that what is fire before it gets abroad, and is fire again when it comes together, doth likewise remain fire during all its journey? Nay, even in the journey it self we have particular testimony that it is fire: for light, returning back from the earth charg'd with little atomes (as it doth in soulttry gloomy weather), heats much more than before; just as fire doth when it is imprisoned in a dense body.

4.  
Philosophers ought not to judge of things by the rules of vulgar people.

Philosophers ought not to judge by the same rules that the common people doth. Their gross sense is all their guide; and therefore they cannot apprehend any thing to be fire that doth not make it self to be known for such by burning them: But, he that judiciously examines the matter, and traces the pedigree and period of it, and sees the reason why, in some circumstances, it burns, and in others, not; is too blame, if he suffer himself to be led by others ignorance, contrary to his own reason. When they, that are curious in perfumes, will have their chamber fill'd with a good scent, in a hot season that agrees not with burning perfumes; and therefore make some odoriferous water be blown about it, by their servants mouths that are dexterous in that ministry, (as is used in *Spain* in the Summer time): every one that sees it done (though on a sudden the water be lost to his eyes and touch, and is only discernable by his nose, yet) is well satisfied that the scent which recreates him is the very water he saw in the glass, extremely dilated by the forcible sprouting of it out from the servants mouth; and will, by little and little, fall down and become again palpable



pable water as it was before ; and therefore doubts not but it is still water, whiles it hangs in the air divided into little atomes. Whereas, one that saw not the beginning of this operation by water, nor observ'd how in the end it shews it self again in water, might the better be excused, if he should not think that what he smel'd were water blown about the air ; nor any substance of it self (because he neither sees nor handles it), but some adventitious quality, he knows not how, adhering to the air. The like difference is between Philosophers that proceed orderly in their discourses, and others that pay themselves with terms which they understand not: The one see evidence in what they conclude; whiles the others guesse wildly at random.

I hope the Reader will not deem it time lost from our main drift, which we take up thus in examples and digressions: for, if I be not much deceived, they serve exceedingly to illustrate the matter. Which I hope I have now rendred so plain, as no man, that shall have well weighed it, will expect that Fire, dilated into that rarified substance which mankind (who, according to the different appearance of things to their sense, gives different names to them) calls Light, should burn like that grosser substance which, from doing so, they call fire; nor doubt, but that they may be the same thing more or less attenuated; as leaf-gold that flies in the air, as light as down, is as truly gold as that in an ingot, which, being heavier then any other substance, falls most forcibly to the ground.

What we have said of the unburning fire (which we call light) streaming from the flame of a Candle, may easily be apply'd to all other lights deprived of sensible heat; whereof some appear with flame, others without it. Of the first sort are the innoxious flames that are often seen on the hair of mens heads and horses manes, on the Masts of ships, over graves, and fat marish grounds, and the like: and of the latter sort are Glow-worms, and the light-conserving stones, rotten wood, some kinds of fish and of flesh when they begin to putrifie; and some other things of the like nature.

Now, to answer the second part of this objection, That we daily see great heats without any light, as well as much light with

5.  
The different names of light and fire proceed from different notions of the same substance.

6.



The reason  
why n any  
times fire and  
head are de-  
prived of  
light.

*non probatur  
ut. id est.*

7.  
What becoms  
of the body of  
light when it  
dies.

without any heat; and therefore light and fire cannot be the same thing: You may call to mind, how Dense bodies are capable of great quantities of Rare ones; and thereby it comes to pass that bodies, which repugn to the dilatation of flame, may nevertheless have much fire inclosed in them. As, in a stove, let the fire be never so great, yet it appears not outwards to the sight; although that stove warm all the rooms near it: So, when many little parts of heat are imprison'd in as many little cells of gross earthly substance, (which are like so many little stoves to them), that imprisonment will not hinder them from being very hot to the sense of feeling; which is most perceptible of dense things. But, because they are choak'd with the closeness of the gross matter wherein they are closed, they cannot break out into a body of flame or light, so to discover their nature: which (as we have said before) is the most unfit way for burning; for we see that light must be condensed to produce flame and fire, as flame must be, to burn violently.

Having thus clear'd the third objection, (as I conceive,) let us go on to the fourth; which requires that we satisfie their inquisition, who ask, what becomes of that vast body of shining light (if it be a body) that fills all the distance between heaven and earth; and vanishes in a moment, as soon as a cloud or the Moon interposes it self between the Sun and us, or that the Sun quits our *Hemisphere*? No sign at all remains of it after its extinction as doth of all other substances, whose destruction is the birth of some new thing. Whither then is it flown? we may be perswaded that a mist is a corporeal substance, because it turns to drops of water upon the twigs that it invirons: and so we might believe light to be fire, if, after the burning of it out, we found any ashes remaining; but experience assures us, that, after it is extinguished, it leaves not the least *vestigium* behind it of having been there.

Now, before we answer this objection, we will intreat our Adversary to call to mind, how we have, in our solution of the former, declared and proved that the light, which (for example) shines from a candle, is no more then the flame is, from whence it springs, the one being condensed and the other dilated; and that the flame is in a perpetual flux of consumption  
about



about the circumference, and of restauration at the center where it sucks in the fewell ; and then we will enquire of him, what becomes of the bodie of flame which so continually dies and is renewed, and leaves no remainder behind it ; as well as he doth of us, what becomes of our body of light, which in like manner is alwaies dying and alwaies springing fresh ? And when he hath well considered it, he will find that one answer will serve for both.

Which is, That, as the fire streams out from the fountain of it, and growes more subtile by its dilatation, it sinks the more easily into those bodies it meets withall : the first of which, and that environs it round about, is aire. With air, then, it mingles and incorporates it self, and, by consequence, with the other little bodies that are mingled with the aire ; and in them it receives the changes which nature works : by which it may be turn'd into the other Elements, if there be occasion ; or be still conserv'd in bodies that require heat.

Upon this occasion, I remember a rare experiment, that a Noble-Man of much sincerity, and a singular friend of mine, told me he had seen: which was, That, by meanes of glasses made in a very particular manner, and artificially placed one by another, he had seen the Sun-beams gather'd together, and precipitated down into a brownish or purplish red powder. There could be no fallacy in this operation : for, nothing whatever was in the glasses when they were placed and disposed for this intent ; and it must be in the hot time of the year, else the effect would not follow. And of this *Magistry* he could gather some dayes near two ounces in a day. And it was of a strange volative nature, and would pierce and imprint his spiritual quality into gold it self (the heaviest and most fixed body we converse withall) in a very short time. If this be plainly so, without any mistaking, then mens eyes and hands may tell them what becomes of light when it dies, if a great deal of it were swept together. But, from what cause soever this experience had its effect, our reason may be satisfied with what we have said above ; for I confesse, for my part, I beleieve the appearing body might be something that came along with the Sun-beams, and was gather'd by them ; but not ther pure substance.

Some peradventure will object those lamps, which both an-  
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An experi-  
ment of some  
who pretend,  
that light  
may be preci-  
pitated into  
powder.



9.  
The Authors  
opinion con-  
cerning lamps  
pretended to  
have been  
found in  
Tombes, with  
inconsumpti-  
ble lights.

cient and modern writers have reported to have been found in Tombes and Urns; long time before closed up from mens repair to them, to supply them with new fewel: and therefore they believe such fires to feed upon nothing; and consequently, to be inconsumptible and perpetual. Which if they be, then our doctrine, that will have light to be nothing but the body of fire perpetually flowing from his center and perpetual dying, cannot be found: for, in time, such fires would necessarily spend themselves in light; although light be so subtile a substance, that an exceeding little quantity of fewel may be dilated into a vast quantity of light. However, there would be some consumption; which, how imperceptible soever in a short time, yet, after a multitude of revolutions of years, must needs discover it self.

To this I answer: That, for the most part, the witnesses, who testifie originally the stories of these lights, are such as a rational man cannot expect from them that exactness or nicitie of observation, which is requisite for our purpose. For, they are usually gross labouring people, who, as they dig the ground for other intentions, Stumble upon these Lamps by chance before they are aware: and commonly they break them in the finding, and imagine they see a glimpse of light; which vanishes before they can in a manner take notice of it, and is, peradventure, but the glistering of the broken glass, or glazed pot, which reflects the outward light, as soon as, by rummaging in the ground and discovering the Glass, the light strikes upon it, (in such manner as sometimes a Diamond, by a certain incountring of light in a dusky place, may, in the first twinkling of the motion, seem to sparkle like fire.) And afterwards, when they shew their broken Lamp, and tell their tale to some man of a pitch of wit above them, who is curious to inform himself of all the circumstances that may concern such lights; they strain their memory to answer him satisfactorily unto all his demands: and thus, for his sake, they persuade themselves to remember what they never saw; and he again, on his side, is willing to help out the story a little. And so after a while, a very formal and particular relation is made of it. As happens in like sort in reporting of all strange and unusual things; when even those, that in their nature



nature abhor from lying, are naturally apt to strain a little and fashion up in a handsome mould, and almost to perswade themselves they saw more than they did: so innate it is to every man, to desire the having of some preeminence beyond his neighbours; be it but in pretending to have seen something which they have not.

Therefore, before I engage my self in giving any particular answer to this objection of pretended inconsumptible lights, I would gladly see the effect certainly averred and undoubtedly proved: For, the testimonies which *Fortunius Licetus* produces (who has been very diligent in gathering them; and very subtle in discoursing upon them; and as the exactest Author that has written upon this subject) do not seem to me to make that certainty, which is required for the establishing of a ground in Philosophy. Nevertheless, if there be any certain experience in this particular, I should think there might be some Art; by circulation of fewel, to maintain the same light for a great company of years: But, I should not easily be perswaded, that either flame or light could be made, without any manner of consuming the body which serves them for fewel.

### CHAP. VIII.

*An Answer to three other Objections formerly  
proposed; against Light being  
a Substance.*

**H**AVING thus defended our selves from their Objections, who would not allow light to be fire; and having satisfied their inquisition, who would know what becomes of it when it dyes, if it be a body: we will now apply our selves to answer their difficulties, who will not let it pass for a body, because it is in the same place with another body; as, when the Sun-beams enlighten all the air, and when the several lights of two distinct Candles are both of them every where in the same room. Which is the substance of the second main objection.

This, of the juttling of the aire, is easily answered thus: that the aire, being a very divisible body, doth without resistance, yield as much place as is requisite for light. And that light,

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though

I.  
Light is not  
really in every  
part of the  
room it en-  
lightens, nor  
fills entirely  
any sensible  
part of it,  
though it seem  
to us to do so.



though our eyes judge it diffused every where, yet is not truly in every point or atome of air : but, to make us see it every where, it suffices that it be in every part of the air which is as big as the black or light of our eye ; so that we cannot set our eye in any position, where it receives not impressions of light. In the same manner as Perfumes, which, though they be so gross bodies that they may be sensibly waisted by the wind, yet to fill the air, that we can put our nose in no part of the room, where a perfume is burned, but we shall smell it : And the like is of mists ; as also of the sprouted water to make a perfume, which we mention'd above.

But, because pure discourses, in such small thrids as these, do but weakly bind such Readers as are not accustom'd to them ; and I would ( if possible ) render this Treatise intelligible to every rational man, how ever little vers'd in Scholastick learning ( among whom I expect it will have a fairer passage, then among those that are already deeply imbued with other principles ) : let us try if we can herein inform our selves by our sense, and bring our eyes for witness of what we say. He then, that is desirous to satisfie himself in this particular, may put himself in a dark room, through which the Sun sends his beams by a cranie or little hole in the wall : and he will discover a multitude of little atomes flying about in that little stream of light ; which his eye cannot discern, when he is environ'd on all sides with a full light. Then, let him examine whether or no there be light in the midst of those little bodies ; and his own reason will easily tell him, that, if those bodies were as perspicuous as the air, they would not reflect upon our eyes the beams by which we see them : And therefore he will boldly conclude, that at the least such parts of them as reflect light to us do not admit it, nor let it sink into them. Then let him consider the multitude of them, and the little distance betwixt one another ; and how nevertheless they hinder not our sight, but we have it free to discover all objects beyond them, in what position soever we place our eye. And, when he thus perceives that these opacous bodies, which are every where, do not hinder the eye from judging light to have an equal plenary diffusion through the whole place that it irradiates ; he can have no difficulty to allow air, ( that is diaphanous,



phanous, and more subtile far then they, and, consequently, divisible into lesser atomes, and, having lesser pores, gives less scope to our eyes to miss light, then they do ) to be every where mingled with light, though we see nothing but light, and cannot discern any breach of it.

Especially, when he shall adde to this consideration, that the subtile body, which thus fills the air, is the most visible thing in the world; and that whereby all other things are seen: and that the air it mingles it self with, is not at all visible, by reason of the extreme diaphaneity of it, and easie reception of the light in every pore of it, without any resistance or reflection: and that such is the nature of light, as it easily drowns an obscure body, if it be not too big: and not onely such, but even other light bodies; for so we know as well the fixed Stars as the Planets are conceal'd from our sight, by the nearness to the Sun, neither the lightness of the one, nor the bigness of the other prevailing against the darkning of an exuperant light; and we have daily experience of the same in very pure chrystal glasses, and in very clear water, which though we cannot discern by our sight if they be certain positions, nevertheless by experience we find that they reflect much light, and consequently have great store of opacous parts. And then he cannot choose but conclude, that it is impossible but light should appear as it doth, to be every where, and to be one continued thing; though his discourse withal assure him it is every where mingled with air.

And this very answer, I think, will draw with it, by consequence, the solution of the other part of the same objection; which is, of many lights joyning in the same place; and the same is likewise concerning the images of colours every where crossing one another without hindrance. But, to raise this contemplation a strain higher, let us consider, how light, being the most rare of all known bodies, is, of its own nature, (by reason of the divisibility that followeth rarity) divisible into lesser parts then any other; and particularly then flame, which, being mixed with smoke and other corpulency, falls very short of light: And this, to the proportion in which it is more rare then the body 'tis compared to. Now, a great \* Mathematician, having devised how to measure the rarefaction of Gun-pow-

2  
The least sensible point of a diaphanous body hath room sufficient to contain both air and light, together with a multitude of beams issuing from several lights, without penetrating one another.  
\* Willibrord Snell.



der into flame, found the *Diameter* fifty times increased; and so concluded, that the body of the flame was, in proportion to the body of the Gun-powder it was made of, as 125000. is to one. Wherefore, by the immediately proceeding consequence, we find that 125000 parts of flame may be couched in the room of one least part of gunpowder; and peradventure many more, considering how porous a body Gun-powder is. Which being admitted, 'tis evident that, although light were as gross as the flame of Gun-powder, and Gun-powder were as solid as gold; yet there might pass 125000. rayes of light, in the space wherein one least part of Gun-powder might be contained: which space would be absolutely invisible to us, and be contained many times in the bigness of the sight of a mans eye. Out of which we may gather, what an infinity of objects may seem to us to cross themselves in the same indivisible place; and yet may have room sufficient for every one to pass his way, without hindring his fellow. Wherefore, seeing that one single light could not send rayes enough to fill every little space of aire that is capable of light, (and the less, the further it is from the flame); 'tis obvious enough to conceive how, in the space where the air is, there is capacity for the rays of many candles.

Which, being well sum'd up, will take away the great admiration how the beams of light, though they be corporeall, can in such great multitudes, without hindering one another, enter into bodies and come to our eye: and will shew, that 'tis the narrowness of our capacities, and not the defect of nature, which makes these difficulties seem so great. For, she hath sufficiently provided for all these subtile operations of fire; as also for the entrance of it into glass, and into all other solid bodies that are Diaphanous (upon which was grounded the last instance the second objection pressed): for, all such bodies being constituted by the operation of fire, (which is alwaies in motion); there must needs be ways left for it both to enter in, and to evaporate out. And, this is most evident in glass: which, being wrought by an extreme violent fire and swelling with it, (as water and other things do, by the mixture of fire) must necessarily have great store fire in it self whiles it is boyling; as we see by its being red hot. And, hence it is that the workmen  
are



are forced to let it cool by degrees in such relentings of fire, as they call their nealing heats: lest it should shiver in pieces, by a violent succeeding of air in the room of the fire; for, that, being of greater parts than the fire, would strain the pore of the glass too suddenly, and break it all in pieces to get ingressions; whereas, in those nealing heats the air being rarer, lesser parts of it succeed to the fire, and leisurely stretch the pores without hurt. And, therefore, we need not wonder, that light passes so easily through glass; and, much less, that it gets through other bodies; seeing the experience of *Alchymists* assures us. 'tis hard to find any other body so impenetrable as glass.

But now, to come to the answer of the first, and, in appearance, most powerful objection, against the corporeity of light; which urges, that its motion is perform'd in an instant, and therefore cannot belong to what is material and cloth'd with quantity. We will endeavour to shew how unable the sense is to judge of sundry sorts of motions of Bodies, and how grossly it is mistaken in them: And then, when it shall appear that the motion of light must necessarily be harder to be observed, then those others I conceive, all that is rais'd against our opinion, by so incompetent a judge, will fall flat to the ground.

3.  
That light  
doth not en-  
lighten any  
room in an in-  
stant; and that  
the great cele-  
rity of its mo-  
tion doth  
make it im-  
perceptible  
to our senses.

First then, let me put the Reader in mind, how, if ever he mark'd children when they play with firesticks, they move and whirle them round so fast, that the motion will close their eyes, and represent an entire circle of Fire to them: and were it somewhat distant, in a dark night, that one play'd so with a lighted Torck, it would appear a constant Wheele of fire, without any discerning of motion in it. And then, let him consider how slow a motion that is, in respect of what 'tis possible a body may participate of: and he may safely conclude, that 'tis no wonder though the motion of light be not descried; and that indeed no argument can be made from thence, to prove that light is not a body.

But, let us examine this consideration a little further, and compare it to the motion of the earth or heavens. Let the appearing circle of the fire be some three foot *Diameter*, and the



time of one entire circulation of it be the fixtieth part of a minute; of which minutes there are 60. in an hour; so that, in a whole day, there will but be 86400. of these parts of time. Now, the *Diameter* of the wheel of fire being but of three foot, the whole quantity of space that it moves, in that atome of time, will be at the most ten foot, which is three paces and a foot; of which parts there are near eleven millions, in the compass of the earth: so that, if the earth be moved round in 24. hours, it must go near 130. times as fast as the Boy's stick, which by its swift motion deceives our eye. But, if we allow the Sun, the Moon, and the fixed Stars to move; how extreme swift must their flight be, and how imperceptible would their motion be, in such a compass as our sight would reach to? And this being certain, that, whether the earth or they move, the appearances to us are the same; 'tis evident, that, as now they cannot be perceiv'd to move (as peradventure they do not) so it would be the very same in shew to us, although they did move. If the Sun were near us and gallop'd at that rate, surely we could not distinguish between the beginning and ending of his race: but there would appear one permanent Line of light from East to West, without any motion at all; as the Torch seems to make, with so much a slower motion, one permanent immoveable wheel of fire.

But, contrary to this effect, we see that the Sun and Stars, by onely being removed further from our eyes, do cosen our sight so grossely, that we cannot discern them to be moved at all. One would imagine, that so rapid and swift a motion should be perceiv'd in some sort or other, (which, whether it be in the earth or in them, is all one to this purpose.) Either we should see them change their places whiles we look upon them, as Arrows and Birds do, when they fly in the Aire: or else, they should make a stream of light bigger then themselves, as the Torch doth. But, none of all this happens. Let us gaze upon them so long and so attentively, that our eyes be dazled with looking; and all that while they seem to stand immovable: and our eyes can give us no account of their journey, till it be ended; They discern it not while it is in doing:  
So



So that, if we consult with no better counsellour then them, we may wonder to see that body at night setting in the West, which in the morning we beheld rising in the East.

But, that which seems to be yet more strange is, that these bodies move cross us, and nevertheless are not perceiv'd to have any motion at all : Consider, then, how much easier it is for a thing that moves towards us to be with us before we are aware. A nimble Fencer will put in a thrust so quick, that the foil will be in your bosome, when you thought it a yard off: because in the same moment you saw his point so far distant ; and could not discern it to move towards you, till you felt the rude salutation it gave you. If then you will compare the body of light, with these others that thus deceive us in regard of motion; you must needs agree it is much rashness to conclude it has no motion, because we cannot discern the succession of it. Consider that it is the subtlest of all the bodies that God has made. Examine the paths of it, which, for the smalness of their thrids, and the extreme divisibility of them, and their pliant application of themselves to whatever hath pores, are almost without resistance. Calculate the strange multiplication of it, by a perpetual momentary renovation of its streams. And cast with your self, with what extreme force it springs out and flies abroad. And, on the other side, reflect how all these things are directly opposite and contrary, in those other great bodies; whose motion nevertheless appears, not to us, till it be done and past. And, when you have well weigh'd all this, you must needs grant, that they, who in this case guided themselves meerely by what appears to their eyes, are ill judgers of what they have not well examin'd.

But, peradventure, some, who cannot all of a sudden be wean'd from what their sence hath so long fed them with, may ask yet further, How it chanches that we have no effects of this motion? It shews not it self in the air, coming to us a far off. It stays not a thought or slackens its speed, in flying so vast a space, as is from the Sun to us. In fine, there is no discovery of it.

4.  
The reason why the motion of light is not discern'd coming towards us; and that there is some reall tardity in it.



But, if *Galileus* his conception be well grounded, that Lightning gives us an inkling of its motion, beginning from a little and encreasing to a greater; or, if *Monsieur des Cartes* his opinion, that it goes slower in refraction, be true: we shall not need to study long for an answer. But, in *Galileus* his experience, it may be the breaking of the cloud which receives that succession of motion we see: and, no slowness that light can acquire, by the resistance of the refracting body, can be so great as to make that difference of lines, which *Monsieur des Cartes* most ingeniously (though, I much doubt, not truly) hath apply'd to yield the reason of refraction; as will appear in our further discourse.

Therefore, these being uncertain, we will, to shew the unreasonableness of this question, suppose there may be some observable tardity in the motion of light; and then ask of them, how we should arrive to perceive it? What sense should we imploy in this discovery? It is true, we are satisfied that sound takes up time in coming to our ears: but it is, because our eyes are nimbler than they, and can perceive, a good way distant, the Carpenters ax falling upon the timber that he hews or the fire flashing out of the cannon, before they hear any news of them: but shut your eyes, or inquire of a blind man; and then neither you nor he can tell, whether those sounds will fill your ears at the very instant they were begotten, or have spent some time in their journey to you. Thus, then, our eyes instruct our ears. But is there any sense quicker than the sight? or means to know, speedier than by our eyes? Or can they see light, or any thing else, until it be with them? We may then assuredly conclude, that its motion is not to be discern'd as it comes upon us; nor it self to be perceiv'd, till its beams are in our eyes.

But, if there be any means to discover its motion, surely it must be in some medium, through which it must struggle to get, as fire doth through Iron; which, increasing there by degrees, at last (when it is red hot) sends beams of light quite through the plate, that, at the first, refused them passage. And it makes to this purpose, that the light-conserving stones, which are gathered in *Italy*, must be set in the Sun for some while, before they retain light: and the light will appear in them,  
when



when they are brought back into the dark, greater or lesser, (until they come to their utmost period), according as they have been longer or a lesser while in the Sun. And our eyes, the longer they remain in the light, the more dazl'd they are if they be suddenly pass'd into the dark. And, a curious Experienter did affirm, that the likeness of any object (but particularly, he had often observ'd it of an iron grate), if it be strongly inlightned, will appear to another, in the eye of him that looks strongly and steadily upon it till he be dazl'd by it; even after he shall have turn'd his eyes from it. And, the wheel of fire could never be made appear to our eye, by the whirling of the firestick we even now spoke of; unless the impression, made by the fire from one place, did remain in the eye, a while after the fire was gone from the place whence it sent that ray. Whence 'tis evident, that light, and the pictures of objects, do require time to settle and to unsettle in a subject. If then light makes a greater impression with time, why should we doubt but the first comes also in time; were our sense so nimble as to perceive it?

But then, it may be objected, that the Sun would never be truly in that place, in which to our eyes it appears to be: because, it being seen by means of the light which issues from it, if that light required time to move in, the Sun (whose motions is so swift) would be removed from the place where the light left it, before that could be with us to give tidings of it. To this, I answer, allowing that peradventure it may be so: Who knows the contrary? Or, what inconvenience would follow, if it be admitted? Indeed, how can it be otherwise? In refraction, we are sure it is so: and therefore at no time, but when the Sun is Perpendicularly over our heads, we can be certain of the contrary; although it should send its light to us in an instant. Unless happily the truth of the case should be, that the Sun doth not move about us, but we turn to his light: and then the objection also loses its aim.

But, the more we press the quickness of light, the more we engage our selves in the difficulty, why light doth not shatter the aire in pieces; as likewise all solid bodies whatever: for, the Masters of Natural Philosophy tells us, that a softer thing

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The Planets  
are not cer-  
tainly ever in  
that place  
where they  
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The reason  
why light be-  
ing a body,  
doth not by  
its motion  
shatter other  
bodies into  
pieces.



with a great velocity, is as powerfull in effect, when it gives a blow, as a harder thing going slowly : And accordingly experience teaches us, that a tallow candle, shot in a Gun, will go through a board or kill a man. Wherefore light, having such an infinite celerity, should also have an unrelistable force, to pierce and shatter, not onely the air, but even the hardest bodies that are. Peradventure some may think it reasonable to grant the consequence (in the circumstances), since experience teaches us, that the congregation of a little light, by a glasse, will set very solid bodies on fire, and will melt metals in a very short space ; which shews a great activity : and the great activity shews a great percussion ; burning being effected by a kind of attrition of the thing burned. And the great force which fire shews in Guns and in Mines ( being but a multiplication of the same ) evidently convinces that, of its own nature, it makes a strong percussion, when all due circumstances concur. Whereas it has but little effect if the due circumstances be wanting ; as we may observe in the insensible burning of so rarified a body as pure spirit of wine converted into flame.

But, we must examine the matter more particularly, and seek the cause, why a violent effect doth not always appear, wherever light strikes. For which we are to note, that three things concur to make a percussion great : The bigness, the density, and the celerity of the body moved. Of which three, there is onely one in light ; to wit, celerity : for it has the greatest rarity, and the rays of it are the smallest parcels of all natural bodies, and therefore, since only celerity is considerable in the account of lights percussions, we must examine what celerity is necessary, to make the stroke of a ray sensible. First then, we see that all the motes of the aire, nay even feathers and straws, do make no sensible percussion when they fall upon us : therefore we must in light have, at the least, a celerity that may be, to the celerity of the straw falling upon our hand (for example,) as the density of the straw is to the density of light ; that the percussion of light may be in the least degree sensible. But, let us take a corn of gunpowder instead of a straw ( between which there cannot be much difference ) : and then, putting that the density of fire is, to the density of Gunpowder, as



1. to 125000. and that the density of the light we have here in the earth is, to the density of that part of fire which is in the Sun's body, as the body of the Sun is to that body which is called *Orbis magnus* (whose *Semidiameter* is the distance between the Sun and the Earth), which must be in subtriple proportion of the *Diameter* of the Sun to the *Diameter* of the great Orb; it follows that 125000. being multiplied by the proportion of the great Orb to the Sun (which *Galileo* tells us is as 1060000000. to one) will give a scantling of what degree of celerity light must have, more than a corn of Gunpowder, to recompence the excess of weight which is in a corn of Gunpowder, above that which is in a ray of light, as big as a corn of Gunpowder. Which will amount to be much greater than the proportion of the *Semidiameter* of *Orbis magnus*, to the *Semidiameter* of the corn of Gunpowder: for if you reckon five grains of Gunpowder to a Barly-corns breadth, and 12. of them in an inch, and 12. inches in a foot, and 3. feet in a pace, and 1000. paces in a mile, and 3500. miles in the *Semidiameter* of the earth, and 1208. *Semidiameters* of the earth in the *Semidiameter* of the *Orbis magnus*, there will be in it but 91324800000000. grains of Gunpowder; whereas the other calculation makes light to be 1325000000000000 times rarer than gunpowder, which is almost ten times a greater proportion than the other. And yet this celerity supplies but one of the two conditions, wanting in light to make its percussions sensible; namely, density. Now, because the same velocity, in a body of a lesser bulk, doth not make so great a percussion as it doth in a bigger body, and that the littleness of the least parts of bodies follows the proportion of their rarity; this vast proportion of celerity must again be drawn into it self, to supply for the excess in bigness that a corn of gunpowder hath over an atome of light: and the product of this multiplication will be the celerity required to supply for both defects. Which evidently shews, it is impossible that a ray of light should make any sensible percussion; though it be a body. Especially, considering that sense never takes notice of what is perpetually done in a moderate degree. And therefore, after this minute looking into all circumstances, we need not have difficulty in allowing to light the greatest celerity imaginable, and a percussion proportionate to such a celerity in so rare a body; and



and yet not fear any violent effect from its blow unless it be condens'd, and many parts of it be brought together to work as if they were but one

7.  
The reason  
why the body  
of light is ne-  
ver perceiv'd  
to be fann'd  
by the wind.

As concerning the last objection, that, if light were a body, It would be fann'd by the wind: we must consider, what is the cause of a thing appearing to be moved; and then examine what force that cause hath in light. As for the first part, we see that, when a body is discern'd now in one place, now in another; then it appears to be moved. And this we see happens also in light; as when the Sun or a candle is carried or moves, the light thereof, in the body of the Candle or Sun, seems to be moved along with it. And the like is in a shining cloud or comet.

But, to apply this to our purpose: We must note, that the intention of the objection is, that the light which goes from the fire to an opacous body far distant, without interruption of its continuity, should seem to be jog'd or put out of its way by the wind that crosses it. Wherein the first failing is, that the Objector conceives light to send *species* to our eye from the midst of its line: whereas with a little consideration he may perceive, that no light is seen by us but that which is reflected from an opacous body to our eye; so that the light he means in his objection is never seen at all. Secondly, 'tis manifest that the light which strikes our eye, strikes it in a straight line, and seems to be at the end of that straight line, wherever that is; and so can never appear to be in another place: but, the light, which we see in another place, we conceive to be another light. Which makes it again evident, that the light can never appear to shake, though we should suppose that light may be seen from the middle of its line; for no part of wind or air can come into any sensible place in that middle of the line with such speed, that new light from the source doth not illuminate it sooner then it can be seen by us: wherefore it will appear to us illuminated, as being in that place; and therefore the light can never appear shaken. And lastly, it is easier for the air or wind to destroy the light, then to remove it out of its place; wherefore, it can never so remove it out of its place, as that we should see it in another place: But, if it should remove it, it would wrap it up within it self and hide it.

In conclusion, after this long dispute concerning the nature  
of



of light : If we consider well what hath been said on both sides, (to which much more might be added, but that we have already trespassed in length, and I conceive enough is said to decide the matter) an equal judge will find the ballance of the question to hang upon these termes; that, to prove the nature of light to be material & corporeal, are brought a company of accidents, well known to be the proprieties of quantitie or bodies, and as well known to be in light. Even so far as that 'tis manifest, light in its beginning, before it be disperfed, is fire; and if again it be gathered together, it shews it self again to be fire. And, the receptacles, of it are the receptacles of a body: being a multitude of pores, as the hardness and coldness of transparent things do give us to understand; of which we shall hereafter have occasion to discourse.

The reasons  
for and against  
lights being a  
body compa-  
red together.

On the contrary side, whatever arguments are brought, against lights being a body, are only negative. As, that we see not any motion of light; that we do not discern where the confines are between light and air; that we see not room for both of them, or for more lights to be together; and the like: which is to oppose negative proofs against affirmative ones; and to build a doctrine upon the defect of our senses; or upon the likeness of bodies which are extremely unlike, expecting the same effects from the most subtile as from the most gross ones. All which, together with the authority of *Aristotle* & his followers, have turned light into darkness, and made us almost deny the light of our own eyes.

Now then, to take our leave of this important question; let us return to the principles from whence we began, and consider that, Seeing Fire is the most rare of the Elements, and very dry; and that out of the former it hath, that it may be cut into very small pieces, and out of the later, that it conserves its own figure, and so is apt to divide whatever fluid body: and joyning to these two principles, that it multiplies extremely in its source: It must of necessity follow, that it sends out in great multitudes little small parts, into the air and other bodies circumfused, with great dilatation, in a spherical manner: And likewise, that these little parts are easily broken; and, new ones still following the former, are still multiplied in straight lines from the place where they break. Out of which 'tis evident

A summary repetition of the reasons which prove that light is fire.



dent that, of necessity, it must, in a manner, fill all places, and that no sensible place is so little, but that fire will be found in it, if the *medium* be capacious. As also, that its extreme least parts will be very easily swallow'd up in the parts of the air, which are humid; and, by their enfolding, be as it were quite lost, so as to lose the appearance of fire. Again, that, in its reflections, it will follow the nature of grosser bodies, and have glidings like them; which is that we call refractions. That little streamings from it will cross one another in excessive great numbers, in an unsensible part of space, without hindering one another. That its motion will be quicker then sense can judge of; and therefore will seem to move in an instant, or to stand still as in a stagnation. That, if there be any bodies so porous with little and thick pores, as that the pores arrive near to equalling the substance of the body; then, such a body will be so fill'd with these little particles of fire, that it will appear as if there were no stop in its passage, but were all filled with fire: and yet, many of these little parts will be reflected. And, whatever qualities else we find in light, we shall be able to derive them out of these principles; and shew that fire must of necessity do what experience teaches us that light doth. That is, to say in one word, it will shew us that fire is light. But, if fire be light, then light must needs be fire. And so we leave this matter.

## C H A P. IX.

*Of Local motion in common.*

I.  
No local motion can be perform'd without succession.

**T**Hough, in the fifth Chapter, we made only earth the pretender in the controversie ag'nst fire, for superiority in activity; (and, in very truth, the greatest force of gravity appears in those bodies which are eminently earthy): nevertheless, both water and air (as appears out of the 4. Chapter of the *Elements*) do agree with earth in having gravity; and gravity, is the chief virtue to make them efficient. So that, upon the matter, this plea is common to all the three Elements.

Wherefore, to explicate this virtue, whereby these three weighty Elements work: let us call to mind what we said in the beginning of the last Chapter, concerning local motion: to wit, that, according as the body moved, or the divider, did more and more enter into the divided body: so, it joyn'd it self to  
some



some new parts of the *Medium* or divided body, and did in like manner forsake others. Whence it happens that in every part of motion, it possesses a greater part of the *Medium* then it self can fill at once. And because, by the limitation and confinedness of every magnitude to just what it is, and no more, 'tis impossible that a lesser body should at once equalize a greater; it followes, that this division or motion, whereby a body attains to fill a place bigger then it self, must be done successively; that is, it must first fill one part of the place it moves in, then another, and so proceed on, till it have measur'd it self with every part of the place, from the first beginning of the line of motion to the last period of it where the body rests.

By which discourse it is evident, that there cannot in nature be a strength so great, as to make the least or quickest moveable that is to pass in an instant, or all together; over the least place that can be imagin'd: for, that would make the moved body (remaining what it is, in regard of its bigness) to equalize and fit a thing bigger then it is. Therefore it is manifest, that motion must consist of such parts as have this nature, that whiles one of them is in being, the others are not yet: and, as by degrees every new one comes to be, all the others that were before do vanish and cease to be. Which circumstance accompanying motion, we call *Succession*.

And, whatever is so done is said to be done in time, which is the common measure of all succession, For, the change of situation of the Stars but especially of the Sun and Moon, is observ'd, more or less, by all mankind; and appears alike to every man: and (being the most known, constant, and uniform succession that men are used to) is, as it were by nature it self, set in their way and offer'd them, as fittest to estimate and judge all other particular successions; by comparing them both to it, and among themselves by it. And accordingly, we see all men naturally measure all other successions, and express their quantities, by comparing them to the revolutions of the Heavens; for, dayes, houres, and yeares, are nothing else but they, or some determinate parts of them; to some of which all other motions and successions must of necessity be refer'd, if we will measure them. And thus we see, how all the mystery of applying time to particular motions is nothing else, but the considering

2.  
Time is the  
common meas-  
ure of all suc-  
cession.



considering how far the Agent that moves the Sun causes it to go on in its journey, whiles the Agent that moves a particular body causes it to perform its motion.

<sup>3</sup>  
What velocity  
is, and that it  
cannot be in-  
finite.

So that 'tis evident, that *Velocity*, is the effect of the super-proportion of the one Agent over a certain *Medium*; in respect of the proportion which another Agent hath to the same *Medium*. And, therefore, Velocity is a quality by which One succession is intrinsically distinguished from Another: though our explication uses to include time in the notions of velocity and tardity. Velocity, then, is the effect (as we said) of more strength in the Agent. And, having before expressed, that velocity is a kind of density; we find that this kind of density is an excellency in succession: as permanent density is an excellency in the nature of Substance; though, an imperfection in the nature of Quantity, (by which we see, that quantity is a kind of base alloy added to substance.) And out of this it is evident that, by how much the quicker the motion is in equall *Mediums*, by so much the agent is the perfecter which causes it to so quick. Wherefore, if the velocity should ascend so much, as to admit no proportion between the quickness of the one and the tardity of the other, all other circumstances being even, excepting the difference of the Agents; then there must be no proportion between the Agents. Nor indeed can there be any proportion between them, though there were never so many differences in other circumstances; as long as those differences be within any proportion. And consequently, you see that, if one Agent be supposed to move in an instant, and another in time; whatever other differences be in the bodies moved and in the *Mediums*, nevertheless the agent which causes motion in an instant will be infinite, in respect of the agent which moves in time. Which is impossible: it being the nature of a body, that greater quantity of the same thing hath greater virtue, then a less quantity hath; and therefore, for a body to have infinite virtue, it must have infinite magnitude.

If any should say the contrary; affirming the infinite virtue may be in a finite body: I ask, whether in half that body (were it divided) the virtue would be infinite or no? If he acknowledge that it would not; I infer thence, that neither in the two parts together there can be infinite virtue: for two finites cannot com-  
pose



pose and make up one infinite, But, if he will have the virtue be infinite in each half; he therein allows that there is no more virtue in the whole body then in one half of it: which is against the nature of bodies. Now, that a body cannot be infinite in greatness is proved, in the *Second Knot* of Mr. *White's first Dialogue. De Mundo*. And thus it is evident, that, by the virtue of pure bodies, there can be no motion in an instant.

On the other side it followes, that there cannot be so little a force in nature, but that, giving it time enough, it will move the greatest weight that can be imagined: For, the things we treat of, being all of them quantities, may, by Division and Multiplication, be brought to equality. As for example; Supposing the weight of a moveable to be a million of pounds; and that the mover is able to move the millioneth part of one of those pounds, in a million of yeares, the millioneth part of a pace, through a *Medium* of a certain rarity: seeing yeers may be multiplied so, as to equalize the force of this mover, to the weight of the moveable: it follows clearly, that this force may move the whole weight of a million of pounds, through the determined *Medium*, in a determinate number of millions of years, a million of paces. For, such a force is equal to the required effect; and by consequence, if the effect should not follow, there would be a compleat cause put, and no effect result from it.

But peradventure 'tis needful to illustrate this point yet further. Suppose then a weight never so great to be A, and a force never so little to be B. Now, if you conceive that some other force moves A, you must withall conceive it moves A some space; since all motion implies necessarily that it be through some space. Let that space be CD. And, because a body cannot be moved a space in an instant, but requires some time to have its motion perform'd in; it follows, that there must be a determin'd time, in which the conceiv'd force must move the weight A through the space CD. Let that time be EF. Now, then, this is evident, that 'tis all one to say, that B moves A; and to say, that B moves A, through a space, in a time; so that, if any part of this be left out, it cannot be understood that B moves A. Therefore to expresse particularly the effect which B is to do upon A, we must say, B must move A a certain  
F space

4.  
No force so little that is not able to move the greatest weight imaginable.



space in a certain time. Which being so, we may in the next place consider, that this effect of moving A may be diminish'd two waies, either because the space 'tis to be moved in is lessened; or the time taken up in its motion is encreas'd: for, as it is a greater effect, to move A through the space CD in a less time than EF, so it is a less effect to move the same A through the space CD in a greater time than EF; or through a less space than CD in the time EF. Now then, this being suposed, that it is a less effect to move A through CD in a greater time than EF: it follows also, that a lesser virtue is able to move it through CD in a greater time than EF, then the virtue which is requir'd to move it through the same space in the time EF. Which if it be once granted (as it cannot be denied), then multiplying the time, as much as the virtue or force required to move A through CD in the time EF is greater then the force B; in so much time the force B will be able to move A through CD. Which discourse is evident, if we take it in common terms: but, it be applied to action, wherein physical accidents intervene; the artificer must have the judgment to provide for them, according to the nature of his matter.

5.  
The chief  
principle of  
Mechanicks  
deduced out  
of the former  
discourse.

Upon this last discourse hangs the Principle which governs *Mechanicks*, to wit, that the force and the distance of weights counterpoysing one another ought to be reciprocal: That is, by how much the one weight is heavier then the other, by so much must the distance of the lighter, from the fixed point upon which they are moved, be greater then the distance of the greater weight from the same point. For 'tis plain, that the weight which is more distant must be moved a greater space; then the nearer weight; in the proportion of the two distances: Wherefore, the force moving it must carry it in a velocity of the said proportion to the velocity of the other; And consequently the Agent, or mover, must be in that proportion more powerful then the contrary mover. And, out of this practise of *Geometricians* in *Mechanicks*, (which is confirm'd by experience) 'tis made evident that, if other conditions be equal, the excess of so much Gravity will make so much Velocity: and so much velocity, in proportion, will recompence so much gravity.

6.  
No moveable  
can passe from

Out of the precedent Conclusions another follows: which is, that nothing receds from quiet or rest, and attains a great degree



degree of Celerity, but it must pass through all the degrees of Celerity that are below the obtain'd degree. And the like is, in passing from any lesser degree of velocity to a greater; because it must pass through all the intermediate degrees of velocity. For, by the declaration of velocity, which we have even now made, we see, that there is as much resistance in the *Medium* to be overcome with speed, as there is for it to be overcome in regard of the quantity, or line of extent of it: because (as we have said) the force of the Agent in counterpoises ought to be increas'd, as much as the line of extent of the *Medium*, which is to be overcome by the Agent in equal time, exceeds the line of extent of the other *Medium*, along which the resistant body is to be moved. Wherefore, it being proved that no line of extent can be overcome in an instant; it follows, that no defect of velocity, which requires as great a superproportion in the cause, can be overcome likewise in an instant.

And, by the same reason, by which we prove that a moveable cannot be drawn in an instant from a lower degree of velocity to a higher, 'tis with no less evidence concluded, that no degree of velocity can be attain'd in an instant: For, divide that degree of velocity into two halves, and if the Agent had overcome the one half, he could not overcome the other half in an instant; much less therefore is he able to overcome the whole (that is, to reduce the moveable from quiet to the said degree of velocity) in an instant.

Another reason may be, because the movers themselves (such movers as we treat of here) are Bodies likewise moved, and consist of parts: whereof not every one part, but a competent number of them, makes the moving body a fit Agent, able to move the proposed body in a proposed degree of celerity. Now, this Agent meeting with resistance in the moveable, and not being in the utmost extremity of density, but condensable yet further, (because it is a body); and every resistance (be it never so small) works something upon the mover (though never so hard) to condense it: the parts of the mover, that are to overcome this resistance in the moveable, must (to work that effect) be condens'd and brought together as close as is needful, by this resistance of the moveable to the mo-



ver; and so, the remote parts of the mover become nearer to the moveable, which cannot be done but successively, because it enclud's local motion. And, this application being likewise divisible, and not all the parts flocking together in an instant to the place where they are to exercise their power: it follows, that, while there are fewer moving parts knit together, they must needs move less and more weakly, then when more or all of them are assembled and applied to that work. So that, the motive virtue encreasing thus, in proportion to the multiplying of the parts applied to cause the motion; of necessity, the effect (which is obedience to be moved, and quickness of motion, in the moveable) must do so too: that is, it must from nothing, or from rest, passe through all the degrees of celerity, until it arrive to that which all the parts together are able to cause.

As for example, when with my hand I strike a ball; till my hand touches it, 'tis in quiet; but then it begins to move; yet with such resistance, that, although it obey in some measure the stroke of my hand, nevertheless it presses the yeelding flesh of my palm, backwards towards the upper and bony part of it. That part then overtaking the other, by the continu'd motion of my hand; and both of them joyning together to force the ball away; the impulse becomes stronger, then at the first touching of it. And, the longer it presses upon it, the more the parts of my hand condense and unite themselves to exercise their force; and the ball therefore must yeeld the more: and consequent, the motion of it grows quicker and quicker, till my hand parts from it. Which condensation of the parts of my hand encreasing successively, by the parts joyning closer to one another, the velocity of the balls motion (which is an effect of it) must also encrease proportionably therto. And in like manner, the motion of my hand and arm must grow quicker and quicker; and pass all the degrees of velocity between rest and the utmost degree it attains unto: For seeing they are the Spirits swelling the Nervs, that cause the arms motion, (as we shall hereafter shew); upon its resistance, they flock from other parts of the body to overcome that resistance. And since their journey thither requires time to perform it in; and the nearest come first: it must needs follow, that, as they grow more and more in number, they must more power-



powerfully overcome the resistance, and consequently, encrease the velocity of the motion, in the same proportion as they flock thither; till it attain that degree of velocity, which is the utmost period that the power which the Agent hath to overcome the resistance of the *medium* can bring it self to. Between which and rest, or any other inferiour degree of velocity, there may be design'd infinite intermediate degrees; proportionable to the infinite divisibility of time, and space, in which the mover moves. Which degrees arise out of the reciprocal yeilding of the *medium*: And that is likewise divisible in the same infinite proportion.

Since then, the power of all natural Agents is limited, the mover (be it never so powerful) must be confined to observe these proportions, and cannot pass over all these infinite designable degrees in an instant; but must allot some time (which hath a like infinity of designable parts) to ballance this infinity of degrees of velocity: and so consequently, it requires time, to attain to any determinate degree. And therefore cannot recede immediately from rest to any degree of celerity, but must necessarily pass through all the intermediate ones.

Thus 'tis evident that all motion which hath a beginning must of necessity increase for some time. And, since the works of nature are in proportion to their causes, it follows that this encrease is in a determinate proportion: Which *Galileus* (to whom we owe the greatest part of what is known concerning motion) teaches us how to find out; and to discover what degree of celerity any movable, that is moved by nature, has, in any determinate part of the space it moves in.

Having settled these conditions of motion; we shall do well in the next place to enquire after the causes of it: as well in the body moved, as also in the mover that occasions the motion. And, because we have already shewed, that local motion is nothing in substance but division: we may determine that those causes which contribute to division, or resist it, are the causes which make or resist local motion. It has also been said, that Density has in it a power of dividing; and that Rarity is the cause of being divided; likewise we have said that fire, by reason of its smal parts, into which it may be cut (which makes them sharp) has also an eminence in dividing: So that we have two qualities, density and tenuity

7.  
The conditions which help to motion, in the movable are three; in the *medium* one.



Dialog. I. of  
Motion.

or sharpness, which concur actively to division. We have told you also how *Galileus* has demonstrated, that a greater quantity, of the same figure and density, has a privilege of descending faster than a lesser. And that privilege consists in this, that the proportion of the *superficies* to the body it limits (which proportion the greater it is, the more it retards) is less in a greater bulk than in a smaller.

We have therefore three conditions concurring to make the motion more efficacious. namely, the density, the sharpness, and the bulk of the movable: and more then these three we cannot expect to find in a moved body. For, quantity hath but three determinations: one, by density & rarity; of which density is one of the three conditions: another, by its parts; as by a foot, a span, &c. and in this way we have found that the greater excels the lesser: the third and last is, by its figure, and in this we find that subtile or edged quantities do prevail over blunt ones. Seeing, therefore, that these three determinations be all that are in quantity; there can be no more conditions in the body moved, (which of necessity is a finite quantity), but the three named.

And, as for the *medium* which is to be divided, there is only rarity and density (the one, to help; the other to hinder) that require consideration, on its side: For, neither figure, nor littleness and greatness, do make any variation in it. And as for the Agent, it is not as yet time, before we have look'd further into the nature of motion, to determine his qualities.

Now then, let us reflect how these three conditions do all agree in this circumstance, that they help nothing to division; unless the body in which they are to be moved and press'd against the body that is to be divided: so that we see no principle to perswade us, that any body can move it self towards any determinate part or place of the universe, of its own intrinsecal inclination. For, besides that the learned Author of the *Dialogues de Mundo* (in his *third Dialogue*, and the *second Knot*) hath demonstrated, that a body cannot move unless it be moved by some extrinsecal Agent; we may easily frame to our selves a conceit, how absurd it is to think that a body, by a quality in it, can work upon it self: as if we should say, that rarity (which is but more quantity) could work upon quantity; or that figure (which is but that the body reaches no further) could work upon

8.  
No body hath  
any intrinsecal  
vertue to  
move it self  
towards any  
determinate  
part of the  
Universe.



upon the body: and in general, that the manner of any thing can work upon that thing whose manner it is. For *Aristotle* and *St. Thomas*, and their Intelligent Commentators, declaring the notion of Quality, tell us, that to be a Quality is nothing else but to be the determination or modification of the thing whose quality it is.

Besides, the natural manner of operation is, to work according to the capacity of the subject: but, when a body is in the midst of an uniform *medium* or space, the subject is equally prepar'd on all sides to receive the action of that body. Wherefore (though we should allow it a force to move), if it be a natural Agent and have no understanding, it must work indifferently on all sides, and by consequence, cannot move on any side. For, if you say, that the Agent in this case (where the *medium* is uniform) works rather upon one side than upon another; it must be because this determination is within the Agent it self, and not out of the circumstant dispositions: which is the manner of working of those substances that work for an end of their own; that is, of understanding creatures, and not of natural bodies.

Now, he that would exactly determine what motion a body has, or is apt to have, determining by supposition the force of the Agent, must calculate the proportions of all these three conditions of the movable, and the quality of the *medium*; which is a proceeding too particular for the intention of our discourse. But, to speak in common, it will not be amiss to examine in what proportion motion doth increase: since we have concluded that all motion proceeds from quiet, by a continual encrease, *Galileus* (that miracle of our age, and whose wit was able to discover whatever he had a mind to employ it about) hath told us that natural motion encreases, in the proportion of the odd numbers. Which, to express by example, is thus: suppose that in the going of the first yard it has one degree of velocity, then in the going of the second yard it will have three degrees, and in going of the third it will have five; and so onwards, still adding two to the degrees of the velocity, for every one to the space. Or, to express it more plainly; if in the first minute of time it goes one yard of space, then in the next minute it will go three yards, in the third it will go five, in the fourth seven; and so forth.

9.  
The encrease  
of motion is  
always made  
in the propor-  
tion of the odd  
numbers.

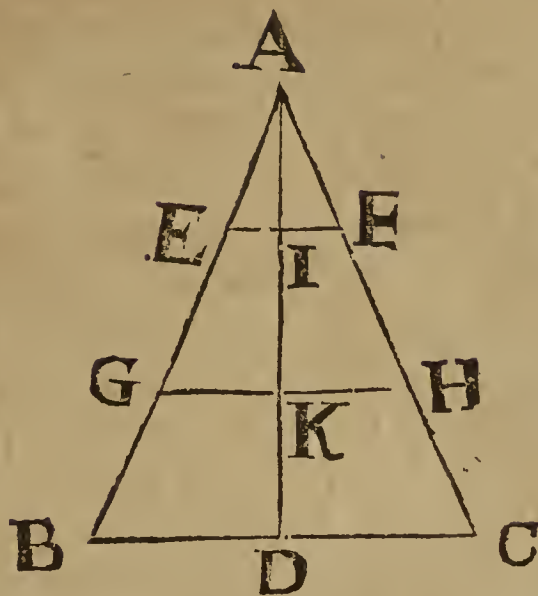


But, we must enlarge this proposition to all motions; as we have done the former, of the encrease it self in velocity: because the reason of it is common to all motions. Which is, that all motion (as may appear out of what we have formerly said) proceeds from two causes: namely, the Agent or the force that moves; and the disposition of the body moved, as it is composed of the three qualities we lately explicated. In which is to be noted, that the Agent doth not move simply by its own virtue, but applies also the virtue of the body moved, which it hath, to divide the *medium* when it is put on. As when we cut with a knife, the effect proceeds from the knife press'd on by the hand; or, from the hand as applying and putting in action the edge and cutting power of the knife. Now this, in *Physics* and *Nature*, is clearly parallel to what, in *Geometry* and *Arithmetick*, the Mathematicians call drawing one number or one side into another; for as, in Mathematicks, to draw one number into another is to apply the number drawn to every part of the number into which it is drawn (as, if we draw three into seven, we make twenty one, by making every unity or part of the number seven to be three; and the like is of lines, in *Geometry*); So, in the present case, to every part of the hands motion, we add the whole virtue of the cutting faculty which is in the knife, and, to every part of the motion of the knife, we add the whole pressing virtue of the hand. Therefore the encrease of the effect, proceeding from two causes so working, must also be parallel to the encrease of the quantities arising out of the like drawing in Mathematicks. But in those, 'tis evident that the encrease is according to the order of the odd numbers; and therefore it must in our case be the like: that is, the encrease must be in the said proportion of odd numbers. Now, that in those the encrease proceeds so, will be evident, if you consider the encrease of an *Equicrure Triangle*; which, because it goes upon a certain proportion of length and breadth, if you compare the encreases of the whole Triangle (that gains on each side) with the encreases of the perpendicular (which gains only in length), you will see that they will proceed in the foresaid proportion of odd numbers.

Which will be better understood, if we set down the demonstration of it. Let the *Equicrure Triangle* be ABC; and, from the point



point A, draw the line A D perpendicular to the line B C, and let it be divided into three equal parts by the lines E F and G H, in the points I & K. And I say, that because the line A K, is twice as long as the line A I, therefore the *trapezium*, E F H G, is thrice as big as the triangle A E F. For, as A K is to A I, so is G H to E F: but the triangle A G H



is, to the triangle A E F, in a double proportion of the line G H to the line E F; which being double the proportion of one triangle to the other must be fourfold: so that subtracting the triangle A E F, the *trapezium* E F G H remains thrice as big as it. And thus the whole triangle gets an encrease of three, while the perpendicular is encreased but one, to make his length two. Which when it comes to three, the *trapezium*, G H C B, that contains the third division of the perpendicular, becomes five times as big as the triangle A E F. For, since the line A D is three times as long as the line A I; and the line B C is three times as long as E F; it follows, that the triangle A B C is nine times as big as the triangle A E F: but A G H is four times as big as A E F: therefore subtracting it from the whole triangle A B C, it leaves the *trapezium* G H C B five times as big as the first triangle A E F. Which proposition is very ingeniously set down by the learned *Monsieur Gassendi*, in his first Epistle, *De motu impresso a motore transato*, to the same purpose for which we bring it. Though we do not here make use of this Scheme and way of demonstration; because we had fallen upon this before his book came abroad: and therefore we only note his, to direct the Reader to it, who peradventure may like his better, than ours. Howbeit we do not conceive that he hath, in his discourse there, arrived to the true reason of the effect we search into: as may appear by what we have already deliver'd.

But, we must not imagine that the velocity of motion will always encrease thus, for as long as we can fancy any motion: but, when it is arrived to the utmost period that such a moveable with such causes is capable of, then it keeps constantly

15.  
No motion  
can encrease  
for ever, with-  
out coming  
to a period.



the same pace, and goes equally and uniformly at the same rate. For since the density of the moveable, & the force of the Agent moving it, (which two cause the motion) have a limited proportion to the resistance of the *medium*, how yeilding soever it be: it must needs follow, that when the motion is arrived to that height which arises out of this proportion, it cannot exceed it, but must continue at that rate; unless some other cause give yet a greater impulse to the movable. For, velocity consisting in this, that the movable cuts through more of the *medium* in an equal time; 'tis evident, that in the encrease of velocity, the resistance of the *medium* which is overcome by it, grows greater and greater, and by little and little gains upon the force of the Agent; so that the superproportion of the Agent grows still lesser and lesser, as the velocity encreases; and therefore at the length they must come to be ballanced, and then the velocity can encrease no more.

And the reason of the encrease of it, for a while at the beginning, is because, coming from rest, it must pass through all the intermediate degrees of velocity, before it can attain to the height of it; which requires time to perform, and therefore falls under the power of our sense to observe. But, because we see it do so for some time, we must not therefore conclude, the nature of such motion is still to encrease, without any period or limit; like those lines that perpetually grow nearer, and yet can never meet: for, we see our reason, examining the causes of this velocity, assures us that, in continuance of time and space, it may come to its height, which it cannot exceed.

And there would be the pitch, at which distance weights being let fall would give the greatest strokes and make greatest impressions. 'Tis true that *Galileus* and *Mersenius* (two exact experimenters) do think they find this verity by their experiences; But, surely that is impossible to be done. For, the encrease of velocity, being in a proportion ever diminishing, must of necessity come to an insensible increase in proportion, before it ends: for, the space which the movable goes through, is still encreased, and the time, wherein it passes through that space, remains still the same little one, as was taken up in passing a less space immediately before; & such little differences, of great spaces passed over in a little time, come soon to be undiscernible by sense. But reason (which shews us that, if velocity never ceased from



from encreasing, it would in time arrive to exceed any particular velocity, and, by consequence, the proportion which the mover has to the medium; because of the adding still a determinate part to its velocity) concludes plainly, that it is impossible motion should increase for ever, without coming to a period.

Now the impression which falling weights make is of two kinds: for, the body into which impression is made either can yield backward, or it cannot. If it can yield backward, then the impression made is a motion: as we see a stroke with a *Racket* upon a Ball, or with a *Pail-mill* beetle upon a Bowl, makes it fly from it. But, if the stricken body cannot yield backwards, then it makes it yield on the sides: And this, in divers matters; for, if the smitten body be drie and brittle, 'tis subject to break it and make the pieces fly round about; but if it be a tough body, it squeezes it into a larger form.

But, because, the effect, in any of these ways, is eminently greater than the force of the Agent seems to be; 'tis worth our labour to look into the causes of it. To which end, we may remember how we have already declared, that the force of the velocity is equall to a reciprocall force of weight in the virtue movent: wherefore the effect of a blow that a man gives with a hammer depends, on the weight of the hammer, on the velocity of the motion, and on the hand, in case the hand accompanies the blow. But, if the motion of the hand ceases before (as when we throw a thing), then only the velocity and the weight of the hammer remain to be consider'd. However, let us put the hand and weight in one sum, which we may equalize by some other virtue or weight: Then, let us consider the way or space which a weight, lying upon the thing, is to go forwards; to do the same effect in the same time as the percussion doth; and, what excess the line of the blow hath over the line of that way or space, such an excess we must add of equal weight or force, to the weight we had already taken: And, the weight composed of both will be a fit Agent to make the like impression. This Problem was proposed to me by that worthy religious man, Father *Mersinius*: who is not content with advancing learning by his own industry and labours; but besides, is alwayes (out of his generous affection to verity) inciting others to contribute to the publick stock of it.

He proposed to me likewise this following question, to wit,  
why.

II.  
Certain problems resolved concerning the proportion of some moving agents compared to their effects.



why there is required a weight of water in double Geometrical proportion, to make a pipe run twice as fast as it did, or have twice as much water run out in the same time? To which I answer out of the same ground, as before: That because, in running twice as fast, there goes out double the water in every part of time; and again, every part of water goes a double space in the same part of time (that is to say, because double the celerity is drawn into double the water, and double the water into double the celerity; therefore the present effect is, to the former effect, as the effect or quadrate of a double line drawn into it self, is to the effect or quadrate of half the said line drawn into it self. And consequently, the cause of the latter effect (which is the weight then) must be to the cause of the former effect (that is, to the former weight) in the same proportion; namely, as the quadrate of a double line is to the quadrate of half that line. And so you see the reason of what he by experience finds to be true. Though I doubt not but when he shall set out the treatise which he has made on this subject, the Reader will have better satisfaction.

In the mean while, an experiment which *Galileo* delivers will confirm this doctrine. He says, that, to make the same Pendant go twice as fast as it did, or to make every undulation of it in half the time it did, you must make the line, at which it hangs, double in Geometrical proportion, to the line at which it hang'd before. Whence it follows, that the circle by which it goes is likewise in double Geometrical proportion. And this being certain, that celerity to celerity has the proportion of force, which weight has to weight; 'tis evident that, as in one case, there must be weight in Geometrical proportion, so in the other case, where only celerity makes the variance, the celerity must be in double Geometrical proportion; according as *Galileo* finds it by experience.

But, to return to our main intent, there is to be further noted that, If the subject stricken be of a proportionate celsibility, it seems to dull and deaden the stroke; whereas, if the thing stricken be hard, the stroke seems to lose no force, but to work a greater effect. Though indeed the truth be, that in both cases the effects are equal; but diverse according to the natures of the things that are stricken; for, no force that once is in nature can be lost, but must have its adequate effect one way or other.

Let



Let us then first suppose the body stricken to be a hard body, of no exceeding bigness: in which case, if the stroke light perpendicularly upon it, it will carry such a body before it. But, if the body be too great, and have its parts so conjoyn'd that they are weaker then the stroke; in this case the stroke drives one part before it, and so breaks it from the rest. But lastly, if the parts of the stricken body be so easily cessible, as without difficulty the stroke can divide them; then it enters into such a body till it has spent its force. So that now, making up our account, we see that an equal effect proceeds from an equal force in all the three cases, though in themselves they be far different. But, we are apt to account that effect greater, which is more considerable to us by the profit or damage it brings us. And therefore we usually say, that the blow, which shakes a wall, or beats it down and kills men with the stones it scatters abroad, hath a greater effect then that which penetrates far into a mud wall, and doth little harm: for that innocuousness of the effect makes that, although in it self it be as great as the other, yet 'tis little observ'd or consider'd.

This discourse draws on another: which is to declare how motion ceases. And to sum that up in short, we say that, When motion comes to rest, it decreases and passes through all the degrees of celerity and tardity, that are between rest and the height of that motion which so declines: and that in the proportion of the odd numbers, as, we declared above, it encreas'd. The reason is clear; because that which makes a motion cease is the resistance it findes: which resistance is an action of a mover that moves something against the body moved, or something equivalent to such an action; wherefore it must follow the laws that are common to all motions; of which kind those two are that we have expressed in this conclusion. Now, that resistance is a countermotion, or equivalent to one is plain by this that any body which is pressed must needs press again on the body that presses it; wherefore, the cause that hinders such a body from yielding is a force moving that body against the body which presses it. The particulars of all which we shall more at large declare, where we speak of the action and reaction of particular bodies.

II.

When a move-  
able comes  
to rest, the mo-  
tion decreases  
according to  
the rules of  
encrease.



*Of Gravity and Levity ; and of Local Motion, commonly term'd Natural.*

I.  
Those motions are call'd natural which have constant causes ; and those violent which are contrary to them.

IT is now time to consider that distinction of motions which is so famous in *Aristotle*; to wit ; that some motions are natural, others violent : and to determine what may be signified by these terms. For seeing we have said that no body hath a natural intrinsecal inclination to any place, to which 'tis able to move it self ; we must needs conclude that the motion of every body follows the percussion of extrinsecal Agents. It seems therefore impossible that any body should have any motion natural to it self : and, if there be none natural, there can be none violent ; and so this distinction will vanish to nothing. But on the other side, Living creatures manifestly shew natural motions ; having natural instruments to perform certain motions : wherefore such motions must of necessity be natural to them. But, these are not the motions we are to speak of ; for, *Aristotle's* division is common to all bodies, or at the least to all those we converse with : and particularly to those which are call'd heavy and light ; which two terms pass through all the bodies we have notice of.

Therefore, proceeding on our grounds before lay'd, to wit, that no body can be moved of it self ; we may determine those motions to be natural to bodies, which have constant causes or percutients to make them always in such bodies ; and those violent, which are contrary to such natural motions. Which being suppos'd, we much search out the causes, that so constantly make some bodies descend towards the center or the middle of the earth, & others to rise and go from the center : by which the world is subject to those restless motions, that keep all things in perpetual flux, in this changing sphere of action and passion.

2.  
The first and most general operation of the Sun is, the making and raising of atoms.

Let us then begin with considering what effects the Sun (which is a constant and perpetual cause) works on inferior bodies, by his being regularly sometimes present and sometimes absent. Observe in a pot of water hanging over a fire, how the heat makes some parts of the water ascend, and others to supply the room by descending ; so that



that, as long as it boyls; 'tis in a perpetual confused motion up and down. Now, having formerly concluded that fire is light, and light is fire; it cannot be doubted but that the Sun serves instead of fire to our Globe of Earth and water, (which may be fitly compared to the boyling pot;) and all the day long draws vapours from those bodies that his beams strike upon. For, he shooting his little darts of fire, in multitudes and in continued streams from his own center, against the *Python*, the earth we live on; they there overtake one another and cause some degrees of heat, as far as they sink in. But, not being able (by reason of their great expansion in their long journey) to convert it into their own nature and set it on fire, (which requires a high degree of condensation of the beams); they but pierce and divide it very subtilly, and cut some of the outward parts of it into extreme little atoms. To which sticking very close, and being in a manner incorporated with them (by reason of the moisture that is in them), they, in their rebound back from the earth, carry them along with them; like a ball that, struck against a moist wall, in its return from it, brings back some of the mortar sticking upon it. For, the distance of the Earth from the Sun is not the utmost period of these nimble bodie's flight; so that, when by this solid body they are stop'd in their course forwards on, they leap back from it, and carry some little parts of it with them: som of them a farther, some of them a shorter journey; according to their littleness and rarity make them fit to ascend. As is manifest by the consent of all Authors that write of the Regions of the Air: who determine the Lower Region to reach as far as the reflection of the Sun; and conclude this Region to be very hot.

For, if we mark how the heat of fire is greatest, when it is incorporated in some dense body, (as in Iron or in Sea-coal); we shall easily conceive that the heat of this Region proceeds mainly, out of the incorporation of light with those little bodies which stick to it in its reflection. And, experience testifies the same, both in our fouldry days, which we see are of a gross temper, and ordinarily go before rain, as also in the hot Springs of extreme cold countrys, where the first heats are unsufferable, which proceed out of the resolution of humidity congeal'd: & in  
hot



hot winds ( which the *Spaniards* call *Bochornos*, from *Boca de horno*, by allusion to the breathing stream of an Oven when it is open'd ), which manifestly shew that the heat of the Sun is incorporated in the little bodies, which compose the steam of that wind. And, by the principles we have already laid, the same would be evident; though we had no experience to instruct us; for, seeing that the body of fire is dry, the wet parts ( which are easiest resolved by fire ) must needs stick to them, and accompany them in their return from the earth.

3.  
The light, rebounding from the earth with atomes, causes two streams in the air; the one ascending, the other descending; and both of them in a perpendicular line.

Now, whiles these ascend, the air must needs cause others that are of a grosser complexion to descend as fast, to make room for the former, and to fill the places they left; that there may be no vacuity in nature. And, to find what parts they are, and from whence they come, that succeed in the room of light and atomes glew'd together that thus ascend; we may take a hint from the Maxime of the *Opticks*, that Light reflecting makes equal angles: whence, supposing the *Superficies* of the earth to be circular, it will follow that a *Perpendicular* to the center passes just in the middle between the two rayes, the incident and the reflected. Wherefore, the air between these two rayes, and such bodies as are in it, being equally pressed on both sides: those bodies which are just in the middle are nearest, and likeliest to succeed immediately, in the room of the light and atomes which ascend from the *Superficies* of the earth: and their motion to that point is upon the *Perpendicular*. Hence 'tis evident, that the Air and all such bodies as descend to supply the place of light and atomes, which ascend from the Earth, descend perpendicularly towards the center of the earth.

And again, such bodies as, by the force of light being cut from the earth or water, do not ascend in form of light, but incorporate a hidden light and heat within them, ( and thereby are rarer then these descending bodies ), must of necessity be lifted up, by the descent of those denser bodies that go downwards, because they ( by reason of their density ) are moved with a greater force. And this lifting up must be in a perpendicular line; because the others, descending on all sides perpendicularly, must needs raise those that are between them equally



equally from all sides : that is, perpendicularly from the center of the earth. And thus we see a motion set on foot, of some bodies continually descending, and others continually ascending: all in perpendicular lines; excepting those which follow the course of lights reflexion.

Again, as soon as the declining Sun grows weaker or leaves our *Horizon*, and his beams, vanishing, leave the little horse-men which rode upon them, to their own temper and nature (from whence they forced them : they, finding themselves, surrounded by a smart descending stream, tumble down again in the night, as fast as in the day they were carried up ; and, crowding into their former habitations, exclude those they find had usurped them in their absence. And thus, all bodies within reach of the Sun's power, but especially our air, are in perpetual motion : the more rarified ones ascending, and the dense ones descending.

Now then, because no bodies, wherever they be (as we have already shew'd), have any inclination to move towards a particular place, otherwise then as they are directed and impel'd by extrinsecal Agents : let us suppose that a body were placed at liberty in the open air. And then, casting whether it would be moved from the place we suppose it in ; and which way it would be moved ; we shall find, it must of necessity happen that it shall descend and fall down, till it meet with some other gross body to stay and support it. For, though of it self it would move no way ; yet, if we find that any other body strikes efficaciously enough upon it, we cannot doubt but it will move that way which the striking body impels it. Now, it is stricken upon on both sides (above and below), by the ascending and the descending atoms; the rare ones striking upon the bottome of it and driving it upwards, and the denser ones pressing upon the top of it and bearing it downwards. But, if you compare the impressions the denser atoms make with those that proceed from the rare ones ; 'tis evident, the dense ones must be the more powerful ; and therefore will assuredly determine the motion of the body in the air that way they go, which is downwards.

Nor need we fear, lest the littleness of the agents, or the feebleness of their strokes, should not be sufficient to work this effect ;

G

4.  
A dense body, placed in the air between the ascending and descending streams must needs descend.



effect; since there is no resistance in the body it self, and the air is continually cut in pieces by the Sun-beams, and by the motions of little bodies; so that the adhesion to air of the body to be moved, will be no hind'rance to this motion: especially, considering the perpetual new percussions, and the multitude of them; and how no force is so little but that, with time and multiplication, it will overcome any resistance.

s.  
A more particular explication of all the former doctrine touching Gravity

But, if any man desires to look on, as it were at one view, the whole chain of this doctrine of *Gravity*: let him turn the first cast of his eyes on what we have said of fire, when we explicated the nature of it; To wit, that it begins from a little source, and, by extreme multiplication and rarefaction, extends it self into a great sphere. And then hee'l perceive the reason, why light is darted from the body of the Sun with that incredible celerity, wherewith its beams fly to visit the remotest parts of the world: and how, of necessity, it gives motion to all circumstant bodies; since it is violently thrust forward by so extreme rarefaction, and, the further it goes, is still the more rarified and dilated.

Next, let him reflect, how infinitely the quickness of lights motion prevents the motion of a moist body; such an one as air is: and then he wil plainly see, that the first motion, which light is able to give the air must needs be a swelling of that moist element, perpendicularly round about the earth. For, the ray descendent, and the ray reflectent, flying with so great a speed, that the air between them cannot take a formal pley any way before the beams of light be on both sides of it: it followes, that, according to the nature of humide things, it must first only swell; for, that is the beginning of motion in them, when heat enters into and works on them. And thus he may confidently resolve himself, that the first motion which light causes in the air will be a swelling of it, between the two rays towards the middle of them; That is, perpendicularly from the surface of the earth.

And, out of this, he will likewise plainly see, that, if there be any other little dense bodies floating in the air, they must likewise mount a little, through this swelling and rising of the air. But, that mounting will be no more, then the immediate parts of the air themselves move: Because this motion is not by way of



of impulse or stroke that the air gives those denser bodies; but by way of containing them in it, and carrying them with it; so that it gives them no more celerity, then to make them go with it self, and as parts of it self.

Then, let him consider, that light or fire, by much beating upon the earth, divides some little parts of it from others: whereof if any become so small and tractable, as not to exceed the strength which the rays have to manage them, the returning rays will, at their going back, carry away with or drive before them such little atoms as they made or met with; and so fill the air with little bodies cut out of the earth.

After this, let him consider, that, when light carries up an atome with it, the light and the atome stick together and make one ascending body; in such sort as, when an empty dish lies upon the water, the air in the dish makes one descendent body together with the dish it self: so that the density of the whole body of air and dish (which, in this case, are but as one body) is to be esteem'd according to the density of the two parts, one of them being allay'd by the other, as if the whole where throughout of such a proportion of density, as would arise out of the composition and kneading together the several densities of those two parts. Now then, when these little compounded bodies of light and earth, are carryed up to a determinate height, the parts of fire or light by little and little break away from them: and thereby the bulk of the part which is left becoms of a different degree of density (quantity for quantity) from the bulk of the entire atome, when light was part of it; and consequently it is denser then it was.

Besides, let him consider, that, when these bodies ascend, they go from a narrow room to a large one, that is, from the centrewards to the circumference; but, when they come down again, they go from a larger, part to a narrower. Whence it followes, that, as they descend, they draw closer and closer together, and by consequence, are subject to meet and fall in one with another: and thereby to increase their bulk, and become more powerful in density; not only, by the loss of their fire, but also by the encrease of their quantity. And so 'tis evident, that they are denser coming down, then going up.

Lastly, let him consider, that, those atoms which went up first,



and are parted from their volative companions of fire or light, must begin to come down apace, when other new atoms (which still have their light incorporated with them) ascend to where they are, and go beyond them by reason of their greater levity. And, as the latter atoms come up with a violence and great celerity, so must the first go down with a smart impulse: and by consequence, being more dense then the air in which they are carryed, must of necessity cut their way through that liquid and rare *Medium*; and go the next way to supply the defect and room of the atoms which ascend, (that is, perpendicularly to the earth) and give the like motion to any body they find in their way, if it be susceptible of such a motion: Which 'tis evident that all bodies are, unless they be stricken by some contrary impulse. For, since a bodies being in a *place* is nothing else, but the continuity of its outside to the inside of the body that contains it and is its place, it can have no other repugnance to local motion, (which is nothing else but a successive changing of place), besides this continuity. Now the nature of density being the power of dividing, and every least power having some force & efficacy, (as we have shew'd above): it follows, that the stroke of every atome (either descending, or ascending) will work something upon any body (though never so big) it chanceth to incounter with and strike upon in its way; unless there be as strong an impulse the contrary way to oppose it. But, it being determin'd, that the descending atoms are denser then those that ascend; it follows, that the descending ones will prevail: And consequently, all dense bodies must necessarily tend downwards to the center (which is to be heavy), if some other more dense body do not hinder them.

6.  
Gravity and levity do not signify an intrinsic inclination to such a motion, in the bodies themselves, which are term'd heavy and light.

Out of this discourse, we may conclude that there is no such thing among bodies, as positive gravity or levity: but that their course upwards or downwards happens to them by the order of nature, which by outward causes gives them an impulse one of these wayes; without which, they would rest quietly wherever they are, as being of themselves indifferent to any motion. But, because our words express our notions, and they are fram'd according to what appears to us; when we observe any body to descend constantly towards our earth, we call it *heavie*; and if it move contrarywise, we call it *light*. But



BUT, we must take heed of considering such gravity and levity, as if they were Entities that work such effects: since upon examination it appears, that these words are but short expressions of the effects themselves, the causes whereof the vulgar of mankind (who impose names to things) do not consider, but leave that work to Philosophers to examine; whiles they onely observe, what they see done, and agree upon words to express that. Which words neither will, in all circumstances, always, agree to the same thing: for, as cork descends in air and ascends in water; so also will any other body descend if it lights among others more rare then it self, and will ascend if it lights among others that are more dense then it. And we term Bodies light and heavy, only according to the course which we usually see them take.

Now, proceeding further on, and considering how there are various degrees of density or gravity; it were irrational to conceive, that all bodies should descend at the same rate, and keep equal pace with one another, in their journey downwards. For, as two knives, whereof one hath a keener edge then the other, being press'd with equal strength into like yielding matter, the sharper will cut deeper then the other: so, if, of two bodies, one be more dense then the other; that which is so will cut the air more powerfully, and descend faster then the other: for, in this case density may be compared to the kniefs edge; since in it consists the power of dividing, as we have heretofore determin'd. And therefore, the pressing them downwards by the descending atomes being equal in both (or peradventure greater in the more dense body; as anon we shall have occasion to touch); and there being no other cause to determine them that way; the effect of division must be the greater, where the divider is the more powerful: Which, the more dense body is; and therefore cuts more strongly through the resistance of the air; and consequently, passes more swiftly that way 'tis determin'd to move.

I do not mean, that the velocities of their descent shall be in the same proportion to one another, as their densities are: for, besides their density, those other considerations, which we have discours'd of above when we examin'd the causes of velocity in motion, must likewise be ballanced. And out of the

7.

The more dense a body is, the more swiftly it descends.

8.

The velocity of bodies descending doth not encrease, in proportion to the difference that may be between their several densities.



comparisons of all them, not out of the consideration of any one alone, results the differences of their velocities : ( nor that neither, but in as much as concerns the consideration of the moveables; for, to make the calculation exact, the *Medium* must likewise be considered, as by and by we shall declare). For, since the motion depends of all them together, though there should be difference between the moveables in regard of one only, and that the rest were equal ; yet the proportion of the difference of their motions must not follow the proportion of their difference in that one regard : because, their difference consider'd single in that regard will have one proportion ; and with the addition of the other considerations (though alike in both ) to their difference in this, they will have another.

As for example, reckon the density of one moveable to be double the density of another moveable ; so that in that regard it has two degrees of power to descend, whereas the other has but one : suppose then the other causes of thier descent to be alike in both ; and reckon them all three : and then joyn these three to the one which is caused by the density in one of the moveables ; as likewise to the two, which is caused by the density in the other moveable : and you will find that, thus altogether, their difference of power to descend is no longer in a double proportion (as it would be, if nothing but their density were considered) but is in the proportion of five to four.

But, after we have consider'd all that concerns the moveables, we are then to cast an eye upon the *Medium* they are to move in ; and we shall find the addition of that decreases the proportion of their difference exceedingly more , according to the celsibility of the *Medium* : Which, if it be Air, the great disproportion of its weight, to the weight of those bodies which men use to take in making experiences of their descent in that yeelding *Medium* , will cause their difference of velocity in descending to be hardly perceptible. Even as the difference of a sharp or dull knife, which is easily perceiv'd in cutting of flesh or bread, is not to be distinguish'd in dividing of water or oyl. And likewise in Weights, a pound and a scruple will bear down a dram, in no sensible proportion of velocity, more then a pound alone would do : and yet, put a pound in that scale in stead of the dram, and then  
the



the difference of the scruple will be very notable. So then, those bodies, whose difference of descending in water is very sensible (because of the greater proportion of weight in water, to the bodies that descend in it), will yield no sensible difference of velocity when they descend in air; by reason of the great disproportion of weight between air and the bodies that descend in it.

The reason of this will clearly shew it self in abstracted proportions: Thus, Suppose air to have one degree of density, and water to have 400. then let the moveable A. have 410 degrees of density; and the moveable B. have 500. Now, compare their motion to one another, in the several *mediums* of air and water: The exuperance of the density of A. to water is 10 degrees, but the exuperance of B. to the same water is 100 degrees; so that B. must have in water swifter then A, in the proportion of 103 to ten, that is, of 10 to one. Then let us compare the exuperance of the two moveables over air. A is 409 times more dense then air; but B is 499 times more dense then it: by which account the motion of B must be in that *medium* swifter then the motion of A, in the proportion of 499 to 409, that is, about 50, to 41: which (to avoid fractions) we may account as 10 to 8. But in water they exceed one another as 10 to one: so that their difference of velocity must be scarce perceptible in air, in respect of what it is in water.

Out of all which discourse, I only infer in common, that a greater velocity in motion will follow the greater density of the moveable; without determining here their proportions, which I leave to them, who make that examination their task: for thus much serves my present turn; wherein I take a survey of nature, but in gross. And my chief drift in this particular is, only to open the way for the discovering how bodies, that of themselves have no propension to any determinate place, do nevertheless move constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecal quality that works upon them; but by the œconomy of nature, that hath set on foot due and plain causes to produce known effects.

Here we must crave patience of the great soul of *Galileus*, (whose admirable learning all posterity must reverence), whiles we reprehend in him that which we cannot term lesse then

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More or less  
gravity pro-  
duces a swift-  
er or a slower



descending a  
heavy body.  
*Aristotles* ar-  
gument, to  
disprove mo-  
tion in *v. cuo*,  
is made good.

absurd: and yet, he not only maintains it in several places, but also professes *Dial. Po. de motu*, pag. 81. to make it more clear: then day. His position is, that more or less gravity contributes nothing at all to the faster or slower descending of a natural body: but, that all the effect it gives to a body is to make it descend or not descend, in such a *Medium*. Which is against the first and most known principal that is in bodies; to wit, that more doth more, and less doth less: for he allows, that gravity causes a body to descend; and yet will not allow, that more gravity causes it to descend more.

I wonder he never mark'd how, in a pair of scales, a superproportion of the overweight in one ballance, lifted up the other, faster than a less proportion of overweight would do; Or that more weight hang'd to a jack made the spit turn faster, or, to the lines of a Clock, made it go faster; and the like.

But, his argument, wherby he endeavours to prove his position, is yet more wonderful: for, finding in pendants unequal in gravity, that the lighter went in the same time almost as fast as the heavier; he gathers from thence, that the different weights have each of them the same celerity, and that it is the opposition of the air, which makes the lighter body not reach so far at each undulation, as the heavier. For reply whereto, first, we must ask him whether experience or reason taught him, that the slower going of the lighter pendant proceeded only from the *Medium*, and not from want of gravity? And when he shall have answer'd (as he needs must) that experience doth not shew this; then we must importune him for a good reason: but I do not find that he brings any at all.

Again, if he admits, (which he doth in expresse terms) that a lighter body cannot resist the *Medium* so much as a heavier body can; we must ask him, whether, it be not the weight that makes the heavier body resist more! which when he has acknowledg'd, that it is; he has therein likewise acknowledg'd that, whenever this happens in the descending of a body, the more weight must make the heavier body descend faster.

But we cannot pass this matter without noting, how himself makes good those arguments of *Aristotle*, which he seems by no means to esteem of. For, since the gravity overcomes the resistance of the *Medium* in ~~some~~ some proportion, it follows, that the



the proportions between the gravity and the *medium* may be multiplied without end: so as, if he suppose that the gravity of a body makes it go at a certain rate in Imaginary Space, (which is his manner of putting the force of gravity,) then there may be given such a proportion of a heavy body to the *medium*, as it shall go in such a *medium* at the same rate; and nevertheless there will be an infinite difference, betwixt the resistance of the *medium* compared to that body, and the resistance of the Imaginary Space compared to that other body which he supposed to be moved in it at the same rate: which no man will stick at confession to be very absurd.

Then turning the scales, because the resistance of the *medium* somewhat hinders gravity, and that with less resistance the heavy body moves faster; it must follow, that, since there is no proportion betwixt the *medium* and imaginary space, there must neither be any proportion betwixt the time in which a heavy body shall pass through a certain quantity of the *medium*, and the time in which it shall pass through as much imaginary space: wherefore, it must pass over so much imaginary space: in an instant. Which is the argument that *Aristotle* is so much laugh'd at for pressing. And in a word, nothing is more evident, then that, for this effect which *Galileo* attributes to gravity, 'tis unreasonable to put a divisible quantity, since the effect is indivisible: And therefore as evident it is that, in his doctrine, such a quality, as intrinsecal gravity is conceiv'd to be, ought not to be put; since every power should be fitted to the effect or end for which it is put.

Another argument of *Galileo* is as bad as this; when he endeavours to prove, that all bodies go of a like velocity, because it happens that a lighter body, in some case, goes faster then a heavier body in another case: as for example, in two pendants, whereof the lighter is in the beginning of its motion, and the heavier towards the end of it; or if the lighter hangs at a longer string, and the heavier at a shorter; we see that the lighter will go faster then the heavier. But this concludes no more, then if a man should prove a lighter goes faster then a heavier, because a greater force can make it go faster: for 'tis manifest that, in a violent motion, the force, which moves a body in the end of its course, is weaker then that which moves it in the beginning: and the like is, of the two strings. Bat



10.

The reason why, at the inferior quarter of a circle, a body descends faster by the arch of that quarter, than by the chord of it.

But here 'tis not amiss to solve a *Probleme* he puts, which belongs to our present subject. He findes by experience, that, if two bodies descend at the same time from the same point and go to the same point, the one by the inferiour quarter of the circle, the other by the *chord* to that arch, or by any other lines which are chords to parts of that arch: he findes (I say) that the moveable goes faster by the arch, then by any of the *chords*. And the reason is evident, if we consider, that the nearer any motion comes to a perpendicular one downwards, the greater velocity it must have: and that in the arch of such a quadrant, every particular part of it inclines to the perpendicular of the place where it is, more then the part of the chord answerable to it doth.

## CHAP. XI.

*An Answer to Objections against the causes of natural motions, aver'd in the former Chapter; and a refutation of the contrary opinion.*

1.

The first objection answered; why a hollow body descends slower then a solid one.

**B**Ut, to return to the third of our Doctrine; There may peradventure be objected against it, that, if the violence of a bodies descent towards the center did proceed only from the density of it (which gives it an aptitude, the better to cut the *medium*, and from the multitude of little atomes descending that strike upon it, and press it the way they go; which is downwards: then it would not import whether the inner part of that body were as solid as the outward parts; for it cuts with only the outward, and is smitten only upon the outward. And yet experience shews us the contrary: for a great bullet of lead, that is solid and lead throughout, descends faster then if three quarters of the *Diameter* were hollow within; and such a one, falling upon any resisting substance, works a greater effect then a hollow one. And a ball of brass that hath but a thin outside of metal, will swim upon the water, when a massie one sinks presently. Whereby it appears, that it is rather some other quality belonging to the very bulk of the metal in it self; and not these outward causes that occasion gravity.

But this difficulty is easily overcome, if you consider, how subtile those atomes are which, descending downwards & striking



ing upon a body in their way, cause its motion likewise downwards: for, you may remember how we have shew'd them to be the subtilest and the minuteſt diviſions that *Light*, the ſubtileſt and ſharpeſt divider in nature, can make. It is then eaſie to conceive, that theſe extreme ſubtile bodies penetrate all others, as light doth glaſs; and run through them, as ſand through a ſmall ſieve, or as water through a ſponge: ſo that they ſtrike, not only upon the *Superficies*, but as well in every moſt interiour part of the whole body; running quite through it all, by the pores of it. And then, it muſt needs follow, that the ſolider it is, and the more parts it has within (as well as without) to be ſtrucken upon; the faſter it go, and the greater effect it muſt work in what falls upon: whereas, if three quarters of the *Diameter* of it within ſhould be fill'd with nothing but air, the atoms would fly without any conſiderable effect through all that ſpace; by reaſon of the rarity & ceſſibility of it.

And, that theſe atoms are thus ſubtile, is manifeſt by ſeveral effects which we ſee in nature. Divers Authors that write of *Egypt* aſſure us, that, though their houſes be built of ſtrong ſtone, nevertheleſs a clod of earth, laid in the inmoſt rooms and ſhut up from all appearing communication with air, will encrease its weight ſo notably; as therby they can judge the change of weather, which will ſhortly enſue. Which can proceed from no other cauſe, but a multitude of little atoms of Saltpeter; which, floating in the air, penetrate through the ſtrongest wals and all the maſſie defences in their way: and ſettle in the cold of earth as ſoon as they meet with it; becauſe it is of a temper fit to entertain, and conſerve, embody them. Delights have ſhewed us the way, how to make the ſpirits or atoms of Snow and Saltpeter paſs through a glaſs veſſel; which *Alchimiſts* hold to be the moſt impenetrable of all they can find to work with. In our own bodies, the aches which feeble parts feel before change of weather, and the heavineſs of our heads and ſhoulders, if we remain in the open air preſently after ſunſet, abundantly teſtifie, that even the groſſer of theſe atoms (which are the firſt that fall) do vehemently penetrate our bodies: ſo as, ſenſe will make us believe what reaſon per-adventure could not.

But, beſides all this, there is yet a more convincing reaſon, why  
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the descending atomes should move the whole density of a body; even though it were so dense that they could not penetrate it, and get into the bowels of it, but must be content to strike barely upon the outside of it. For, nature has so order'd the matter, that, when dense parts stick close together, and make the length composed of them to be very stiff, one cannot be moved but that all the rest (which are in that line) must likewise be thereby moved: so that, if all the world were composed of atoms close sticking together, the least motion imaginable must drive on all that were in a straight line, to the very end of the world. This you see is evident in reason; and experience confirms it, when, by a little knock given at the end of a long beam, the shaking (which makes sound) reaches sensibly to the other end. The blind man, that governs his steps by feeling in defect of eyes, receives advertisements of remote things through a staff which he holdeth in his hands; peradventure more particularly than his eyes could have directed him. And the like is of a deaf man, that hears the sound of an Instrument; by holding one end of a stick in his mouth, whiles the other end rests upon the Instrument. And some are of opinion (and they not of the rank of vulgar Philosophers) that, if a staff were as long as to reach from the Sun to us, it would have the same effect in a moment of time. Although, for my part, I am hard to believe we could receive an advertisement so far; unless the staff were of such a thickness as, being proportionable to the length, might keep it from facile bending: for, if it should be very plyant, it would do us no service; as we experience in a thrid, which, reaching from our hand to the ground, if it knock against any thing, makes no sensible impression in our hand.

So that, in fine, reason, sense, and authority, all of them shew us, that, the less the atomes should penetrate into a moving body, by reason of the extreme density of it, the more efficaciously they would work, and the greater celerity they would cause in its motion. And, hence we may give the fullest solution to the objection above; Which was to this effect: that, seeing division is made only by the *superficies* or exterior part of the dense body: and the virtue whereby a dense body works is onely its resistance to division; which makes it apt to divide: it would follow, that a hollow bowl of brass or iron should be as

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heavy as a solid one. For, we may answer, that, seeing the atoms must strike through the body; and a cessible body doth not receive their strokes so firmly as a stiffe one, nor can convey them so far: if to a stiff *superficies* there succeed a yielding inside, the strokes must of necessity lose much of their force; and consequently, cannot move a body full of air with so much celerity, or with so much efficacy, as they may a solid one.

But then you may peradventure say, that, if these strokes of the descending atomes upon a dense body were the cause of its motion downwards, we must allow the atomes to move faster than the dense body; that so they may still overtake it and drive it along, and enter into it: whereas, if they should move slower than it, none of them could come in their turn to give it a stroke; but it would be past them, and out of their reach before they could strike it. But it is evident (say you), out of these pretended causes of this motion, that such atomes cannot move so swiftly downwards, as a great dense body; since their littleness and their rarity are both of them hindering to their motion. Therefore this cannot be cause of that effect which we call gravity.

To this I reply, That to have the atoms give these blows to a descending dense body, 'tis not requir'd that their natural and ordinary motion should be swifter than the descent of such a dense body; but the very descent of it occasions their striking it; for, as it falls and makes it self a way through them, they divide themselves before it, and swell on the sides and a little above it; and presently close again behind it and over it, as soon as it is past. Now, that closing, to hinder vacuity of space is a sudden one, and thereby attains great velocity; which would carry the atoms in that degree of velocity further than the descending body, if they did not encounter with it in their way to retard them: which encounter and tarding implyes such strokes upon the dense body, as we suppose to cause this motion. And the like we see in water, into which letting a stone fall, presently the water, that was divided by the stone and swells on the sides higher then it was before, closes upon the back of the descending stone; and follows it so violently, that, for a while after, it leaves a purling hole in the place where the stone went down: till, by the repose of the stone, the water returns likewise to its quiet; and so its *superficies* becomes even.

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body.



3.  
A curious question left undecided.

In the third place, an enquiry occurs emergent out of this doctrine, of the cause of bodies moving upwards and downwards: Which is, Whether there would be any natural motion deep in the earth, beyond the activity of the Sun beams? for, out of these principles, it follows that there would not: and consequently there must be a vast Orb in which there would be no motion of gravity or levity. For, suppose the Sun beams might pierce a thousand miles deep into the body of the earth; yet there would still remain a mass, whose *Diameter* would be near 5000 miles, in which there would be no gravitation nor the contrary motion.

For my part, I shall make no difficulty to grant the inference; as far as concerns motion caused by our Sun: for, what inconvenience would follow out of it? But, I will not offer at determining, whether there may not be enclosed within that great sphere of earth some other fire, (such as the *Chymists* talk of), an *Archeus*, a *Demogorgon* seated in the centre, like the heart in animals, which may raise up vapours and boyl an air out of them, and divide gross bodies into atoms; and accordingly give them motions answerable to ours, but in different lines from ours, according as that fire or Sun is situated: Since the far-searching Authour of the *Dialogues de Mundo* hath left that speculation undecided, after he had touched upon it in the *Twelfth knot* of his *first Dialogue*.

4.  
The fourth objection answered; Why the descent of the same heavy bodies is equal in so great inequality of the atoms which cause it.

Fourthly, it may be objected, that, if such descending atoms, as we have described, were the cause of a bodies gravity and descending towards the center, the same body would, at divers times, descend more and less swiftly: for example, after midnight, when the atoms begin to descend more slowly, the same body would descend more slowly in a like proportion, and not weigh so much as it did in the heat of the day. The same may be said of Summer and Winter; for, in Winter time, the atoms seem to be more gross, and consequently, to strike more strongly upon the bodies they meet with in their way as they descend: yet, on the other side, they seem in the Summer to be more numerous, as also to descend from a greater height; both which circumstances will be cause of a stronger stroke and more vigorous impulse on the body they hit. And the like may be objected of divers parts



parts of the World; for, in the Torrid Zone it will always happen as, in Summer, in places of the Temperate Zone, and in the Polar times, as in deepest winter: so that no where there should be any standard or certainty in the weight of bodies, if it depended upon so mutable a cause. And it makes to the same effect, that a body, which lies under a thick rock, or any other very dense body that cannot be penetrated by any great store of atoms, should not be so heavy as it would be in the open and free air, where the atoms in their compleat numbers have their full strokes.

For answer to these and such like instances, we are to note, first, that 'tis not so much the number or violence of the percussion of the striking atoms, as the density of the thing stricken, which gives the measure to the descending of a weighty body; and the chief thing, which the stroak of the atoms gives to a dense body, is a determination of the way which a dense body is to cut to it self: therefore multiplication or lessening of the atoms will not make any sensible difference, betwixt the weight of one dense body where many atoms strike, and another body of the same density where but a few strike; so that the stroak downwards of the descending atoms, be greater then the stroke upwards of the ascending atoms, and thereby determines it to weigh to the Centrewards, and not rise floating upwards; which is all the sensible effect we can perceive.

Next, we may observe, that the first particulars of the objection do not reach home to enfeeble our doctrine in this particular; although we admit them to be in such sort as they are proposed: for they withal imply such a perpetual variation of causes, ever favourable to our position, that nothing can be infer'd out of them to repugne against it. As thus: When there are many atoms descending in the air, the same general cause which makes them be many makes them also be light, in proportion to their multitude; And so, when they are few they are heavy: likewise, when the atoms are light, the air is rarified and thin; and when they are heavy, the air is thick. And so, upon the whole matter, 'tis evident, that we cannot make such a precise and exact judgement



ment of the variety of circumstances, as to be able to determine when there is absolutely more cause of weight, and when less. And, as we find not weight enough in either side of these opposite circumstances to turn the scales in our discourse; so likewise we find the same indifference in experience it self: for, the weights we use do weigh equally in mysty weather and in clear; and yet, in rigor of discourse, we cannot doubt but that, in truth, they do not gravitate or weigh so much (though the difference be imperceptible to sense) when the air is thick and foggy, as when its pure and rarified. Which thickness of the *Medium*, when it arrives to a very notable degree, (as for example to water) makes then a great difference of a heavy bodies gravitation in it: and accordingly we see a great difference between heavy bodies descending in water and in air; though between two kinds of air none is to be observ'd, their difference is so smal in respect of the density of the body that descends in them. And therefore, since an assured and certain difference in circumstances makes no sensible inequality in the affect; we cannot expect any from such circumstances, as we may reasonably doubt whether there be any inequality among them or no.

Besides that, if in any of the proposed cases a heavy body should gravitate more, and be heavier one time than another: yet by weighing it we could not discern it; since the counterpoise (which is to determine its weight) must likewise be in the same proportion heavier then it was. And, besides weighing, no other means remains to discover its greater gravitation, but to compare it to Time in its descent: and I believe that, in all such distances as we can try it in, its inequalities will be no whit less difficult to be observ'd that way, then any other.

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The reason  
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der it.

Lastly, to bend our discourse particularly to that instance of the objection; where it is conceiv'd that, if gravity or descending downwards of bodies proceeded from atoms striking on them as they move downwards, it would follow, that a stone or other dense body lying under shelter of a thick, hard, and impenetrable adamantine rock, would have no impulse downwards; and consequently would not weigh there. We may note, that no body whatever, compacted by physical causes and agents, can be so dense and imporous, but that  
such



such atoms as these we speak of must be in them, and in every part of them, and every where pass through and through them; as water doth through a sieve or through a sponge: and this universal maxime must extend as far as the Sun, or any other heat communicating with the Sun, reaches and is found.

The reason whereof is, because these atoms are no other thing, but such extreme little bodies as are resolved by heat, out of the main stock of those massie bodies upon which the Sun and heat do work. Now then, it being certain, out of what we have heretofore said, that all mixt bodies have their temper and consistence and generation, from the mingling of fire with the rest of the Elements that compose them; and from the concoction or digestion which fire makes in those bodies: 'tis evident, that no mixt body whatever, nor any sensible part of a mixt body, can be void of pores capable of such atoms, or be without such atoms passing through those pores; which atoms by mediation of the air (that likewise hath its share in such pores) must have communication with the rest of the great sea of air, and with the motions that pass in it. And consequently, in all and every sensible part of any such extreme dense and pretended impenetrable body (to the notice wherof we can arrive), this percussion of atoms must be found; and they will have no difficulty in running through, nor, by means of it, in striking any other body lying under the shelter of it: and thus, both in & from that hard body, there must be still an uninterrupted continuation of gravity, or of descending towards the *centre*.

To which we may adde, that the stone or dense body cannot lie so close to the rock that covers it, but that some air must be between, (for if nothing were between, they would be united, and become one continued body;) and in that air (which is a Creek of the great Ocean of air spread over the world, that is every where bestrew'd with moving atoms, and which is continually fed, like a running stream, with new air that drives on the air it overtakes) no doubt but there are descending atoms, as well as in all the rest of its main body: and these descending atoms, meeting with the stone, must needs give some stroke upon it; and that stroke (be it never so little) cannot chuse but work some effect, in making the stone remove a little that

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way they go ; and that motion, wherby the space is enlarg'd between the stone and the shell'ring rock, must draw in a greater quantity of air and atoms to strike upon it. And thus, by little and little, the stone passes through all the degrees of tardity, by which a descending body parts from rest : which is by so much the more speedily done, by how much the body is more eminent in density. But this difference of time, in regard of the atoms strokes only, and abstracting from the bodies density, will be insensible to us : seeing (as we have said) no more is required of them, but to give a determination downwards.

6.  
The reason  
why some bo-  
dies sink,  
others swim.

And, out of this, we clearly see the reason why the same atoms, striking upon one body lying on the water, make it sink ; and upon another they do not. As for example, if you lay upon the *superficies* of some water a piece of iron and a piece of cork, of equal bigness and of the same figure ; the iron, will be beaten down to the bottom, and the cork will float at the top. The reason wherof is, the different proportions of the comparison of their densities with the density of water : for ( as we have said ) the efficacy and force of descending is to be measured by that. So then the strokes of the atoms being more efficacious upon water then upon cork, because the density of water is greater then the density of cork, considering the abundance of air that is harbor'd in the large pores of it ; it followes, that the atoms will make the water go down more forcibly then they will cork : But, the density of iron exceeding the density of water, the same strokes will make the iron descend faster then the water ; and consequently, the iron must sink in the water, and the cork will swim upon it.

And this same is the cause, why, if a piece of cork be held by force at the bottom of the water, it will rise up to the top, as soon as the violence is taken away that kept it down : for, the atoms strokes having more force on the water then on the cork, they make the water sink and slide under it ; first, a little thin plate of water, and then another, a little thicker, and so by degrees more and more, till it hath lifted the cork quite up to the top.

7.  
The fifth ob-  
jection an-  
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Fifthly, it may be objected, that these atoms do not descend always perpendicularly, but sometimes slopingly ; and in that case, if their strokes be the cause of dense bodies moving, they should



should move sloping, and not downward. Now, that these atoms descend sometimes slopingly, is evident: as when (for example) they meet with a stream of water, or with a strong wind, or even with any other little motion of the air, such as carries feathers up and down hither and thither; which must needs waft the atoms in some measure along with them their way. Seeing then that such a gentle motion of the air is able to put a feather out of its way, notwithstanding the percussions of the atoms upon it; why shall it not likewise put a piece of iron out of its way downwards, since the iron hath nothing from the atoms but a determination to its way? But much more, why should not a strong wind, or a curreant of water, do it? since the atoms themselves, that give the iron its determination, must needs be hurried along with them?

descending  
of heavy bo-  
dies in  
streams.

To this we answer, that we must consider how any wind or water, which runs in that sort, is it self originally full of such atoms, which continually, and every where, press into and cut through it, in pursuing their constant perpetual course of descending; in such sort as we shewed, in their running through any hard rock or other densest body. And these atoms make the wind or water primarily tend downwards; though other accidental causes impel them secundarily to a sloping motion, And still, their primary natural motion will be in truth strongest; though their not having scope to obey that, but having enough to obey the violent motion, makes this become the more observable. Which appears evidently out of this, that, if there be a hole in the bottome of the pipe that conveys water slopingly, be the pipe never so long, and consequently the sloping motion never so forcible; yet the water will run out at that hole, to obey its more powerful impulse to the centrewards, rather than continue the violent motion, in which it had arrived to a great degree of celerity.

Which being so; 'tis easie to conceive that the atoms in the wind or water, which move perpendicularly downwards, will still continue the irons motion downwards, notwithstanding the *Mediums* sloping motion: since the prevailing force determines both the iron and the *Medium* downward; and the iron has a superproportion of density to cut its way, according as the prevalent motion determines it.



But, if the descending atoms be in part carried along down the stream by the current of wind or water, yet still the current brings with it new atoms into the place of those that are carried away; and these atoms, in every point or place wherever they are, of themselves tend perpendicularly downwards, though they are forced from the compleat effect of their tendance, by the violence of the current: so that, in this case, they are moved by a declining motion, compounded of their own natural motion and the forced one with which the stream carries them. Now then, if a dense body fall into such a current where these different motions give their several impulses, it will be carried (in such sort as we say of the atoms, but in another proportion) not in a perpendicular but in a mixt declining line, compounded of the several impulses which the atoms and current give it (in which also 'tis to be remembred, how the current gives an impulse downwards, as well as sloping, and peradventure the strongest downwards): and the declination will be more or less, according as the violent impulse prevails more or less against the natural motion.

But this is not all that is to be consider'd, in estimating the declination of a dense bodies motion, when it is sinking in a current of wind or water. You must remember that the dense body it self has a particular virtue of its own (namely its density) by which it receiv's and prosecutes more fully its determination downwards; and therefore the force of that body, in cutting its way through the *Medium*, is also to be considered, in this case as well as above, calculating its declining from the perpendicular: and out of all these causes will result a middle declination; compounded of the motion of the water or wind both ways, and of its own motion by the perpendicular line. And since, of these three causes of a dense bodies motion, its own virtue, in prosecuting by its density the determination it requires, is the most efficacious by much, after it has once receiv'd a determination from without; its declination will be but little, if it be very dense and heavy. But if it recede much from density, as so have some near proportion to the density of the *Medium*, the declination will be great. And in a word, according as the body is heavier or lighter, the declination will be more or less, in the same current: though not exactl.



exactly according to the proportion of the diminishing of its density, as long as there is a superproportion of its density to the *Medium*; since such a superproportion ( as we have declared heretofore ) makes the *Mediums* operation upon the dense body scarce considerable.

) And hence you see why a stone or piece of iron, is not carried out of its way, as well as a feather: because the stones motion downwards is greater and stronger then the motion of a feather downwards; And by consequence, the force, that can turn a feather from its course downwards, is not able to deturn a stone. And if it be repli'd, that it may be so order'd that the stone shall have no motion, before it be in the stream of a river; and notwithstanding it will still move downwards: we may answer, that, considering the little declivity of the bed of such a stream, the strongest motion of the parts of the stream must necessarily be downwards, and consequently, they will beat the stone downwards. And, if they do not the like to a feather or other light body, 'tis because other parts of the stream get under the light body, and beat it upwards; which they have not power enough to do to the stone.

Sixthly, it may be objected, that if Elements do not weigh in their own Spheres, then their gravity and descending must proceed from some other cause, and not from this percussion of the atoms we attribute to it: which percussion we have determin'd goes through all bodies whatever, and beats upon every sensible part of them. But, that Elements weigh not in their own Spheres appears out of the experience of a *Syphon*; for, though one leg of a *Syphon* be sunk never so much deeper into the body of the water, then the other leg reaches below the *superficies* of the water; nevertheless, if once the outward leg become full of water, it will draw it out of the other longer leg. Which it should not do, if the parts of water that are comprised within their whole bulk did weigh: since the bulk of water is much greater in the sunk leg then in the other; and therefore these should rather draw back the other water into the Cistern, then be themselves drawn out of it into the air.

To this we answer, that 'tis evident, the Elements, do weigh in their own Spheres, at least, as far as we can reach to their Spheres,

8.  
The sixth objection answered: and that all heavy Elements do weigh in their own Spheres.



for we see that a ball once stuff'd hard with air is heavier then an empty one. Again, more water would not be heavier then less, if the inward parts of it did not weigh : and, if a hole were dig'd in the bottome of the Sea, the water would not run into and fill it, if it did not gravitate over it. Lastly, there are those who undertake to distinguish, in a deep water, the divers weights which several parts of it have, as they grow still heavier and heavier towards the bottom : and they are so cunning in this art, that they profess to make instruments, which, by their equality of weight to a determinate part of the water, shall stand just in that part, and neither rise or fall higher or lower ; but if it be put lower, it shall ascend to its exact equally weighing Orbe of the water, and if it be put higher, it shall descend till it comes to rest precisely in that place. Whence 'tis evident, that parts of water do weigh within the bulk of their main body ; and of the like we have no reason to doubt, in the other two weighty Elements.

As for the opposition of the *Syphon*, we refer that point to where we shall have occasion to declare the nature of that engine, on set purpose. And there we shall shew, that it could not succeed in its operation, unless the parts of water did gravitate in their main bulk, into which one leg of the *Syphon* is sunk.

9.  
The seventh  
objection an-  
swer'd, and  
the reason  
why we do  
not feel the  
course of the  
air and atoms  
that beat con-  
tinually upon  
us.

Lastly, it may be objected, that, if there were such a course of atoms as we say, and their strokes were the cause of so notable an effect as the gravity of heavy bodies ; we should feel it palpably in our own bodies which experience shews us we do not.

To this we answer, first, that there is no necessity we should feel this course of atoms : since by their subtilty they penetrate all bodies ; and consequently, do not give such strokes as are sensible. Secondly, if we consider that dusts, and straws, and feathers light upon us without causing any sense in us ; much more we may conceive that atoms (which are infinitely more subtile and light) cannot cause in us any feeling of them. Thirdly, we see that what is continual with us, and mingled in all things, doth not make us take any especial notice of it : and this is the cause of the smiting of atoms. Nevertheless, peradventure we feel them in truth, as often as we feel hot and cold weather, and in all Catars or other such changes ; which as it were  
sink



sink into our body without our perceiving any sensible cause of them: for, no question these atomes are the immediate causes of all good and bad qualities in the air. Lastly, when we consider, that we cannot long together hold out our arm at length, or our foot from the ground; and reflect upon such like impotencies of our resisting the gravity of our own body: we cannot doubt but that, in these cases, we feel the effect of these atomes, working upon those parts; though we cannot, by our sense, discern immediately that these are the causes of it.

But now it is time to draw our Reader out of a difficulty, which may peradventure have perplexed him in the greatest part of what he hath hitherto gone over. In our investigation of the *Elements* we took for a principle thereto, that gravity is sometimes more, sometimes less, then the density of the body in which it is: but in our explication of rarity and density, and again, in our explication of gravity, we seem to put that gravity and density is all one. This thorn, I apprehend, may, in all this distance, have put some to pain: but it was impossible for me to remedy it; because I had not yet deliver'd the manner of gravitation. Here then I will do my best to assuage their grief; by reconciling these appearing repugnancies.

We are therefore to consider, that density (in it self) signifies a difficulty to have the parts of its subject separated one from another; and that gravity (likewise in it self) signifies a quality, by which a heavy body descends towards the center; or (which is consequent thereto) a force to make another body descend. Now, this power, we have shew'd, belong to density: so far forth as a dense body, being stricken by another, doth not yield by suffering its parts to be divided; but, with its whole bulk strikes the next before it and divides it, if it be more divisible then it self is. So that you see Density has the name of *Density*, in consideration of a *passive* quality, or rather of an impassibility which it hath: and the same density is call'd *Gravity*, in respect of an *active* quality—it has, which follows this impassibility. And both of them are estimated by the different respects which the same body or subject, in which they are, has to different bodies that are the terms whereto it is compared: for the active quality, or Gravity, of a dense body, is esteem'd, by its respect to the body it strikes upon; whereas its

10.  
How, in the same body, gravity may be greater than density, and density than gravity; though they be the same thing.



Density includes a respect singly to the body that strikes it.

Now 'tis no wonder that this change of comparison works a disparity in the denominations: and that thereby the same body may be conceiv'd to be more or less impartible, then it is active or heavy. As for example, let us of a dense Element take any one least part, which must of necessity be, in its own nature and kind, absolutely impartible; and yet 'tis evident that the gravity of this part must be exceeding little, by reason of the littleness of its quantity: so that thus you see an extremity of the effect of density, joyn'd together in one body (by the accident of its littleness) with a contrary extremity of the effect of gravity (or rather with the want of it) each of them within the limits of the same *species*. In like manner it happens that the same body in one circumstance is more weighty, in another (or rather in the contrary) is more partible: So water in a Pail, because 'tis thereby hinder'd from spreading abroad, has the effect of gravity predominating in it, but if it be pour'd out, it has the effect of partibility more. And thus it happens that, meerly by the gradation of rarity and density, one dense body may be apt, out of the general course of natural causes, to be more divisible then to be a divider: though, according to the nature of the degrees consider'd absolutely in themselves, what is more powerful to divide, is also more resistant and harder to be divided. And this arrives in that degree which makes water; for, the falling and beating of the atomes upon water hath the power both to divide and make it descend; but so, that by making it descend it divideth it. And therefore we say it has more gravity then density; though it be the very density of it which is the cause that makes it partible, by the working of one part upon another: for, if the atomes did not find the body so dense as it is they could not, by their beating upon one part make another be divided.

So that, a dense body to be *more* heavy then dense signifies nothing else, but that it is in *such* a degree of density, that some of its own parts, by their being assisted and set on work by a general cause (which is the fall of the atomes), are powerful enough to divide other adjoining parts, of the same density with them, one from another: as we see water pour'd out of an Ewer into a Basin, where there is already other water, has the power to divide the water in the Basin, by the assistance



stance of the celerity which it gets in descending. And now I hope the Reader is fully satisfied that there is no contradiction in putting Density and Gravity to be the same thing materially: and that nevertheless the same thing may be more heavy then dense, or more dense then heavy, as we took it, to our several purposes, in the investigation of the *Elements*.

Having thus laid an intelligible ground to discover how these motions that are general to all bodies and are natural in chief, are contrived by nature; we will now endeavour to shew, that the contrary position is not only voluntary, but also impossible. Let us therefore suppose that a body has a quality to move it downwards. And first we shall ask, what *downwards* signifies? For, either it signifies towards a fix'd point of Imaginary Space; or towards a fix'd point of the Universe; or towards some Moveable point. As for the first, who would maintain it must have more imagination then judgment; to think that a natural quality could have an essence determin'd by a *nothing*, because we can frame a conceit of that nothing. As for the second, 'tis very uncertain whether any such point be in nature: for, as for the centre of the earth, 'tis clear that, if the earth be carried about, the centre of it cannot be a fixed point. Again, if the centre signifies a determinate point in the earth that is the *Medium* of gravity or of quantity, 'tis chang'd as often as any dust lights unequally upon any one side of the earth, which would make that side bigger then it was, and, I doubt, a quality cannot have moral considerations, to think that so little does no harm. As for the third position, likewise 'tis not intelligible how a quality should change its inclination or essence; according to the change that should light now to make one point, now another, be the centre to which it should tend.

Again, let us consider that a quality has a determinate essence. Then, seeing its power is to move, & to move signifies to cut the *Medium* 'tis moved in; it belongs to it of its nature, to cut so much of such a *Medium*, in such a time: So that, if no other cause be added, but that you take, precisely & in *abstract*, that quality, that *Medium*, and that time; this effect will follow, that *so much* motion is made. And, if this effect should not follow, 'tis clear, that The being able to cut so much, of such a *Medium*, in such a time, is not the essence of this quality, as it was, supposed to be. Dividing then the time and the *Medium*, half the motion should be

II.

The opinion, of gravities being an intrinsic inclination of a body to the centre, refuted by reason.



be made in half the time, a quarter of the motion in a quarter of the time ; and so without end, as far as you can divide. But this is demonstratively impossible ; since 'tis demonstrated, that a moveable coming from rest must of necessity pass through all degrees of tardity ; and therefore, by the demonstration cited out of *Galileus*, we may take a part in which this gravity cannot move its body, in a proportionate part of time, through a proportionate part of the *medium*.

12.  
The same opinion refuted by several experiences.

But because, in natural *Theorems*, experiences are naturally required ; let us see whether nature gives us any testimony of this verity. To that purpose we may consider a Plummet hang'd in a small string from a beam ; which being lifted up gently on the one side at the extent of the string, and permitted to fall meerly by the power of gravity, will ascend very near as high on the contrary side, as the place it was held in from whence it fell. In this experiment we may note two things : First, that, if gravity be a quality, it works against its own nature in lifting up the plummet ; seeing its nature is only to carry it down. For, though it may be answer'd, that 'tis not the gravity, but another quality, called *vis impressa*, which carries it up : nevertheless it cannot be denied, but that gravity is either the immediate, or at least the mediate cause which makes this *vis impressa* : the effect whereof being contrary to the nature of gravity, 'tis absurd to make gravity the cause of it ; that is, the cause of an essence, whose nature is contrary to its own. And the same argument will proceed, though you put not *vis impressa*, but suppose some other thing to be the cause of the plummets remounting ; as long as gravity is said to be a quality : for still gravity must be the cause of an effect contrary to its own inclination, by setting on foot the immediate cause to produce it.

The second thing we are to note in this experiment of the plummets ascent is, that if gravity be a quality, there must be as much resistance to its going up, as there was force to its coming down. Therefore there must be twice as much force to make it ascend, as there was to make it descend ; that is to say, there must be twice as much force as the natural force of the gravity is : for there must be once as much to equallize the resistance of the gravity ; and then another time as much, to carry it



it as far through the same *Medium* in the same time. But 'tis impossible that any cause should produce an effect greater then it self.

Again, the gravity must needs be in a determinate degree, and the virtue that makes the plummet remount ( whatever it be ) may be put as little as we please ; and, consequently, not able to oversway the gravity alone, if it be an intrinsecal quality, and yet the plummet will remount : in which case you put an effect without a cause.

Another experience we may take from the force of sucking : For, take the barrel of a long Gun perfectly bored, and set it upright with the breech upon the ground ; and take a bullet that is exactly fit for it, but so as it stick not any where ( both the barrel and it being perfectly polished ) : and then if you suck at the mouth of the barrel, ( though never so gently ), the bullet will come up so forcibly, that it will hazard the striking out your teeth. Now, let us consider what force were necessary to suck the bullet up, and how very slowly it would ascend ; if in the barrel it had as much resistance to ascend, as in the free air it has inclination to go down. But, if it had a quality of gravity natural to it, it must of necessity have such resistance : whereas, in our experiment, we see it comes as easily as the very air. So that, in this example as well as in the other, nature teaches us that gravity is no quality.

And all or most of the arguments which we have urg'd against the quality of gravity, in that explication we have consider'd it in, have force likewise against it ; although it be said to be an Inclination of its subject to move it self to unity with the main stock of its own nature : as divers witty men put it. For, this supposition doth but change the intention or end of gravity, and is but to make it another kind of intellectual or knowing Entity, that determines it self to an other end : which is as impossible for a natural quality to do, as to determine it self to the former ends. And thus much the arguments we have proposed do convince evidently, if they be apply'd against this opinion.



## CHAP. XII.

*Of Violent Motion.*

1.  
The State of  
the question  
touching the  
cause of vio-  
lent motion.

**A**Nd thus we have given a short scantling, wherby to understand in some measure the causes of that motion we call natural, by reason it has its birth from the universal Oeconomy of nature here among us; that is, from the general working of the Sun, wherby all natural things have their course: and by reason that the cause of it is at all times and in all places constantly the same. Next which the order of discourse leads us to take a survey of those forced motions; whose first causes the more apparent they are, the more obscurity they leave us in, to determine by what means they are continued.

When a Tennis-ball is stroken by a Racket, or an Arrow shot from a Bow, we plainly see the causes of their motion: namely the strings, which, first yielding and then returning with a greater celerity, cause the missives to speed so fast towards their appointed homes. Experience informs us what qualities the missives must be endued with, to move fast and stedily. They must be so heavy, that the air may not break their course; and yet so light, that they may be within the command of the stroke which gives them motion: the striker must be dense, and in its best velocity: the angle which the missive is to mount by (if we will have it go to its furthest randome) must be the half of a right one: and lastly, the figure of the missive must be such, as may give scope to the air to bear it up, and yet not hinder its course by taking too much hold of it. All this we see: But when with all we see, that the mover deserts the moveable as soon as he has given the blow; we are at a stand, and know not where to seek for that which afterwards makes it flie. For, motion being a transient, not a permanent, thing, as soon as the cause ceases that begot it, in that very point it must be at an end; and as long as the motion continues, there must be some permanent cause to make it do so: so that, as soon as the Racket or bow string go back and leave the ball or arrow, why should not they presently fall straight down to the ground?

2  
That the me-  
dium is the  
only caus,  
which conti-  
nues violent  
motion.

*Aristotle* and his followers have attributed the cause hereof to the air: but *Galileo* relishes not this conception. His arguments



ments against it are (as I remember) to this tenor : First, air, by reason of its rarity and divisibility, seems not apt to conserve motion : next, we see that light things are best carried by the air ; and it has no power over weighty ones : lastly , it is evident that air takes most hold of the broadest *superficies* ; and therefore an arrow would fly faster broad waies then long waies, if this were true. Nevertheless , since every effect must have a proportionable cause from whence it immediately flows, and a body must have another body to thrust it on as long as it moves ; let us examin what bodies touch a moveable whilst it is in motion, as the only means to find an issue out of this difficulty ; for, to have recourse to a quality or impressed force, for deliverance out of this straight, is a shift that will not serve the turn in this way of discourse we use. In this Philosophy no knot admits such a solution.

If then we enquire, what body 'tis that immediately touches the ball or arrow while it flies ; we shall find none others does so but the air and the atoms in it, after the strings have given their stroke and are parted from the missive. And, though we have *Galileo's* authority and arguments, to discourage us from believing the air can work this effect : yet, since there is no other body , besides it, left for us to consider in this case ; let us at the least examin how the air behaves it self, after the stroke is given by the strings. First then tis evident that, as soon as the rocket or bow-string shrinks back from the missive , and leavs a space between the missive and it ( as 'tis clear it does, as soon as it has stricken the resisting body ), the air must needs clap in with as much velocity as they retire ; and with somewhat more ; because the missive goes forward at the same time, and therefore the air must hasten to overtake it, least any vacuity should be left between the string and the arrow. 'Tis certain likewise, that the air on the sides also, upon the division of it, slides back and helps to fill that space which the departed arrow leaves void. Now, this forcible closing of the air at the nock of the arrow must needs give an impulse or blow upon it : If it seem to be but a little one, you may consider 'tis yet much greater, then what the air and the bodies swimming in it at the first give to a stone falling from high ; and how at the last those little atoms, that drive a stone



stone in its natural motion, with their little blows force it per-adventure more violently and swiftly, than any impelling agent we are acquainted with can do. So that, the impulse which they make on the arrow, pressing violently upon it after such a vehement concussion and with a great velocity, must needs cause a powerful effect, in that which of it self is indifferent to any motion any way.

3.  
A further ex-  
plication of  
the former  
Doctrine.

But, unless this motion of the air continue to beat still upon the arrow, it will soon fall to the ground, for want of a cause to drive it forward; and because the natural motion of the air (being then the only one) will determine it downwards. Let us consider then, how this violent rending of the air, by the blow the bow-string gives to the Arrow, must needs disorder the little atones that swim to and fro in it, and that (being heavier then the air) are continually descending downwards. This disorder makes some of the heavier parts of them get above others, that are lighter then they; which they not abiding presse upon those that are next them, and they upon their fellows: so that there is great commotion and undulation caused in the whole masse of air round about the arrow: which must continue some time before it can be settled; and it being determin'd by the motion of the arrow that way that it slides, it follows, that all this commotion and undulation of the air serves to continue the arrow in its flight. And thus, faster then any part behind can be settled, new ones before are stir'd; till the resistance of the *medium* grows stronger then the impulse of the movers.

Besides this, the arrow pressing on the air before it, with a greater velocity then the air (which is a liquid rare body) can admit, to move all of a piece without breaking: it must of necessity happen, that the parts of the air immediately before the arrow be driven upon others further off, before these can be moved to give place unto them; so that in some places the air becomes condens'd, and consequently in others rarified. Which also the wind we make in walking (which will shake a paper, pin'd loosely at the wall of a chamber towards which we walk), and the cooling air caus'd by fanning when we are hot do evidently confirm. So that it cannot be doubted, but condensation and rarefaction of the air must necessarily follow the



the motion of any solid body : which being admitted 'tis evident that a greater disorder, and for some remarkable time, must necessarily be in the air ; since it cannot brook to continue in more rarity or density than is natural to it. Nor can weighty and light parts agree to rest in an equal height or lowness ; which the violence of the arrows motion forces them to for the present. Therefore it cannot be deni'd, but that, though the arrow slide away, there still remains behind it ( by this condensation and confusion of parts in the air ) motion enough to give impulse to the arrow ; so as to make it continue its motion after the bowstring has left it.

But here will arise a difficulty : which is, how this clapping in and undulation of the air should have strength and efficacy enough to cause the continuance of so smart a motion, as is an arrow shot from a bow. To this, I need no other argument for an answer, then to produce *Galileo's* testimony, how great a body one single mans breath alone can, in due circumstances, give a rapid motion to : and withal, let us consider, how the arrow and the air about it are already in a certain degree of velocity ; that is to say, the obstacle that would hinder it from moving that way (namely, the resistance of the air) is taken away, and the causes that are to produce it (namely the determining of the airs and atomes motion that way) are heightned. And then we may safely conclude that the arrow, which of it self is indifferent to be moved upwards or downwards or forwards, must needs obey that motion, which is caused in it by the atomes and the air's pressing upon it : either according to the impulse of the string, or ( when the string begins to flag ) according to the beating that follows the general constitution of nature, or in a mixt manner, according to the proportions that these two hold to one another. Which proportions *Galileus* (in his 4 *Dialogue of Motion*) has attempted to explicate very ingeniously: but, having miss'd in one of his suppositions, to wit, that forced motion upon an Horizontal line is throughout uniform, his great labours therein have taken little effect, towards the advancing the knowledge of nature, as he pretended ; for, his conclusions succeed not in experience (as *Mersenius* assures us, after very exact trials), nor can they in their reasons be fitted to nature.

So that, to conclude this point, I find no difficulty in allowing this.

4.  
That the air  
has strength  
enough to  
continue vio-  
lent motion  
in a move-  
able. *Dial. 1.  
of motion, pag.  
98.*



this motion of the air strength enough to force the moveable onwards, for sometime after the first mover is sever'd from it; (and long after we see no motions of this nature endure: ) so that we need seek no further cause for the continuance of it; but may rest satisfied upon the whole matter, that, since the causes and circumstances our reason suggests to us are, after mature and particular examination, proportionable to the effects we see, the doctrine we deliver must be sound and true.

5.  
An answer to  
the first objection; that air  
is not apt to  
conserve motion. And how  
violent motion comes  
to cease.

For the establishing wherof, we need not ( considering what we have already said ) spend much time in solving *Galileo's* arguments against it; seeing, out of what we have set down, the answers to them appear plain enough. For, first, we have assign'd causes how the air may continue its motion, long enough to give as much impression as is needful to the arrow, to make it go on as it does. Which motion is not requisite to be near so great in the air behind the arrow ( that drives it on ) as what the arrow causes in the air before it: for, by reason of its density, it must needs make a greater impression in the air it cuts, than the air that causes its motion, would do of it self without the mediation of the arrow. As, when the force of a hand gives motion to a knife to cut a loaf of bread, the knife, by reason of the density and figure it has, makes a greater impression in the loaf then the hand alone would do. And this is the same that we declared in the natural motion of a heavy thing downwards; to which we assigned two causes; namely, the beating of the atoms in the air, falling down in their natural course to determine it the way it is to go; and the density of the body, that, cutting more powerfully then those atoms can do, gives ( together with their help ) a greater velocity to the moveable, then the atoms of themselves can give.

Nor imports it that our resolution is against the general nature of rare and dense bodies, in regard of conserving motion; as *Galileo* objects. For, the reason why dense bodies conserve motion longer then rare bodies is because, in regard of their dividing virtue, they get, in equal time, a greater velocity: Wherfore, seeing velocity is equal to gravity, it follows, that resistance works not so much upon them as upon rare bodies; and therefore cannot make them cease from motion



tion so easily, as it does rare bodies. This is the general reason for the conservation of motion in dense bodies. But because, in our case, there is a continual cause which conserves motion in the air, the air may continue its motion longer, than of it self it would do: not in the same part of air, which *Galileus* (as it seems) aim'd at; but in divers parts, in which the moveable successively is.

Which being concluded, let us see how the forced motion comes to decrease and be ended. To which purpose we may observe, that the impression which the arrow receives from the air that drives it forwards, being weaker than that which it receiv'd at first from the string, (by reason that the air is not so dense, and therefore cannot strike so great a blow); the arrow does not, in this second measure of time, (wherein we consider the impulse given by the air only) cut so strongly the air before it, nor press so violently upon it, as in the first measure when the string parting from it did beat it forwards: for, till then, the velocity encreases in the arrow, as it does in the string that carries it along, which proceeds from rest at the fingers loose from it, to its highest degree of velocity; which is, when it arrives to the utmost extent of its jerk, where it quits the arrow. And therefore the air now doth not so swiftly, nor so much of it, rebound back from before, and clap it self behind the arrow, to fill the space that else would be left void by the arrows moving forward; and consequently, the blow it gives in the third measure to drive the arrow on, cannot be so great as the blow was immediately after the strings parting from it, which was in the second measure of time: and therefore the arrow must needs move slower in the third measure, than it did in the second; as formerly it moved slower in the second (which was the air's first stroke) than it did in the first, when the string drove it forwards. And thus successively in every moment of time, as the causes grow weaker, & weaker, by the encrease of resistance in the air before, and by the decrease of force in the subsequent air; so the motion must be slower and slower, till it come to pure cessation.

As for *Galileu's* second argument, that the air has little power over heavy things; and therefore he will not allow it to be the cause of continuing forced motions in dense bodies: I wish he could as well have made experience, what velocity of motion

6.  
An answer to the second objection, that the air has no power over heavy bodies.

a mans



a mans breath might produce in an heavy bullet lying upon an even, hard, and slippery plain, (for a table would be too short) as he did, how admirable great a one it produced in pendants hanging in the air; and, I doubt not but he would have granted it as powerful in causing horizontal motions, as he found it in the undulations of his pendants. Which nevertheless sufficiently convince how great a power, air has over heavy bodies. As likewise the experience of wind-guns assures us, that air duly applyed is able to give greater motion to heavy bodies, than to light ones: For, how can a straw or feather be imagin'd possibly to fly with half the violence, as a bullet of lead doth out of one of those Engines? And, when a man sucks a bullet upwards in a perfectly bored barrel of a Gun, which the bullet fits exactly (as we have mention'd before); with what a violence doth it follow the breath, and ascend to the mouth of the barrel? I remember to have seen a man, that was uncautious and sucked strongly, that had his foreteeth beaten out by the blow of the bullet ascending.

This experiment (if well look'd into) may peradventure make good a great part of this Doctrine, we now deliver. For, the air, pressing in behind the bullet at the touch-hole, gives it its impulse upwards; to which the density of the bullet being added, you have the cause of its swiftness and violence, (for a bullet of wood or cork would not ascend so fast and so strongly); and the sucking away of the air before it, takes away that resistance, which otherwise it would encounter with, by the air lying in its way: and its following the breath with so great ease shews (as we touch'd before) that of it self, 'tis indifferent to any motion, when nothing presses upon it, to determine it a certain way.

7.  
An answer to  
the third ob-  
jection, that  
an arrow  
should fly fa-  
ster broadways  
than long ways

Now to *Galileo's* last argument, that an arrow should fly faster broad-ways than long-ways, if the air were cause of its motion; there needs no more to be said, but that the resistance of the air before hinders it, as much as the impulse of the air behind helps it on: So that nothing is gain'd in that regard, but much is lost in respect of the figure, which makes the arrow unapt to cut the air so well when it flies broad-ways, as when 'tis shot long-ways; and therefore, the air being weakly cut, so much of it cannot clap in behind the arrow and drive it on, against the resistance before, which is much greater.

Thus far with due respect, and with acknowledging remembrance



brance of the many admirable mysteries of nature which that great man hath taught the world, we have taken liberty to dispute against him: because this difficulty seems to have driven him, against his *Genius*, to believe that in such motions there must be allow'd a quality imprinted into the moved body, to cause them; which our whole scope, both in this and all other occasions where like qualities are urged, is to prove superfluous and ill grounded in nature, and to be but meer terms to confound and leave in the dark, whoever is forced to fly to them.

## CHAP. XIII.

*Of three sorts of violent motion, Reflection, Undulation, and Refraction.*

**T**He motion we have last spoken of, because 'tis ordinarily either in part or wholly, contrary to gravity, (which is accounted the natural motion of most bodies), uses to be call'd *violent* or *forced*. And thus, you have deliver'd you the natures and causes both of *Natural* and of *Forced Motion*; yet it remains that we advertise you of some particular kinds of this forced motion; which seem to be different from it, but indeed are not. As first, the motion of *Reflection*: which, if we but consider how forced motion is made, we shall find it is nothing else but a forced motion, whose line whereon 'tis made is, as it were, snapp'd in two by the encounter of a hard body. For even, as we see in a spout of water strongly shot against a wall, the water following drives the precedent parts first to the wall; and afterwards, coming themselves to the wall, forces them again another way from the wall: so, the latter parts of the torrent of air, which is caused by the force that occasion'd the forced motion, drives the former parts first upon the resistant body, and afterwards again from it. But, this is more eminent in light than in any other body; because light doth less resist gravity; and so observes the pure course of the stroke, better than any other body; from which others, for the most part, decline some way by reason of their weight.

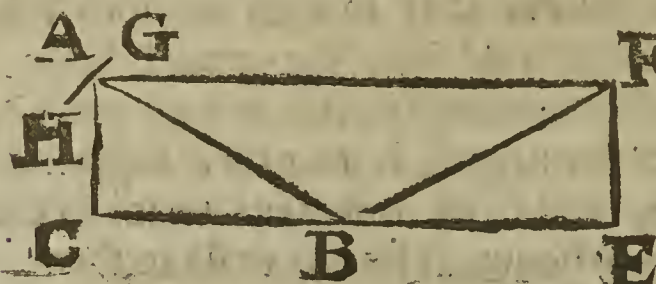
Now, the particular law of reflection is, that the line incident, & the line of reflection must make equal angles, with that line of the resistant *superficies* w<sup>ch</sup> is in the same *superficies* with themselves. The demonstration wherof that great wit, *Renatus des Cartes*, hath

I.  
That reflection is a kind of violent motion.

2.  
Reflection is made at equal angles.

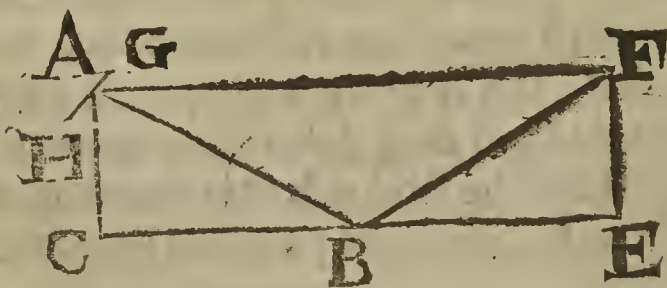


hath excellently set down, in his book of *Dioptricks*, by the example of a ball stricken by a Racket against the earth, or any resisting body: the substance wherof is, as follows.



In the *Rectangle Parallelogramme* A E, let C E be the *superficies* of the earth; A, the point from which the Racket H G strikes the Ball, by the line A B, to the point B

in the *superficies* of the Earth: and let us consider C to be on the left hand, and E on the right. Now we are to shew that the ball will rebound by the line B F, to the point F, in the same time in which it went from A to B; and so make the angle A B C equal to the angle F B E. For the effecting wherof, we must abstract, according to the manner of *Mathematicians*, from all Physical inequalities; and suppose the *superficies* C E to be Mathematically plain, and the force of the racket to continue equally strong in B as it is in A: for though in truth neither of these be rigorously so; nevertheless, because there is no sensible defect in any operation that depends on them, 'tis the same to our purpose as if they were Mathematically so. We see then that the Racket H G, in a certain time, drives the Ball from A to B: that is to say, from the left hand to the right, as far as from C to B; and from above to downwards as far as from A to C. We see again, that the *superficies* C E is not contrary to this motion of the Ball as it goes from the left hand to the right; for the line C E lies likewise that way: but is contrary to it, as it



goes from above downward; for in that course the *superficies* C E encounters and puts a period to the line A C. And therefore the motion of

the ball, when it meets with the *superficies* C E, must be changed from the line A C, so much as the *superficies* C E is contrary to it; that is, quite backwards as far as it depends on that opposition. Therefore, when the Ball is come to B, it must go from thence in the same proportion of left to right hand, and from below upwards; as it came before, from left to right



hand, and from above downwards, when it came from A to B. And consequently, it must, in equal time, have passed another line from left to right hand, as long as the line C B; and at the same time, another from below upwards as long as A C: which will of necessity make it hit in the point F, at the end of so much more time as it spent in going from A to B; and so make the two Angles A B C and F B E equal, as every one knows that has but saluted *Euclide*.

The motion which we call *Undulation* needs no further explication: for 'tis manifest, that, since a Pendent, when 'tis removed from its perpendicular, will restore it self therto by the natural force of gravity, and that in so doing it gains a velocity, (and therefore cannot cease on a suddain); it must needs be carried, out of the force of that motion, directly the contrary way: till, the force of gravity overcoming the velocity, it must be brought back again to the perpendicular; which being done likewise with velocity, it must send it again towards the place from which it fell at the first. And in this course of motion it must continue for a while, every Undulation being weaker then other; till at last it quite ceases, by the course of nature settling the air in its due situation, according to the natural causes that work upon it. And in this very manner also is performed that Undulation we see in water, when it is stir'd from the natural situation of its Spherical *superficies*.

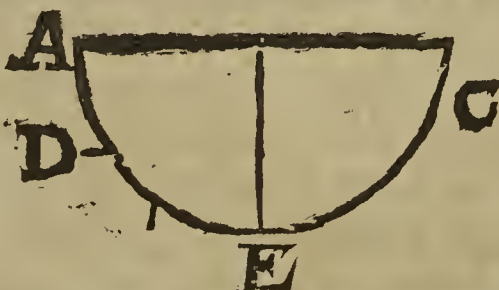
*Galileo* hath noted, that the time in which the Undulations are made which follow one another of their own accord, is the same in every one of them; and that, as much time precisely is taken up in a pendants going a very short arch towards the end of its vibration, as was in its going the greatest arch at the beginning of its motion. The reason wherof seems strange to him, and he thinks it an accident natural to the body out of its gravity; and that this effect convinces, it is not the air which moves such bodies. Whereas, in truth, 'tis clearly the air which causes this effect: Because the air, striving at each end (where it is furthest from the force of the motion) to quiet it self, gets at every bout somewhat upon the space; and so contracts that into a shorter arch.

But, 'tis a great wonder to me, that *Galileo* should make a wonder

3.  
The causes  
and properties  
of Undulation



wonder of this effect, to the reason of which he hath laid so fair a foundation upon another occasion, had he but reflected on it. For ( in his *fourth Dialogue*, of *Motion* ) he hath demonstrated, that a natural movable descending in the quarter of a circle, from what part soever it begins, spends equal time to come to the lowest point, as if it came from any other part : so that a Pendant, being brought up to any height by the force of a former motion downwards, will be sure to spend as much time in going down from thence to the *Perpendicular*, as it did at the first when it was let fall from the greatest height. Now I subsume, that the pendants ascending being the effect of the velocity of its motion gain'd in descending immediately before ; the said velocity must be able to carry it, in the same time, to a height proportionate to that, to which the velocity, gain'd in the first fall, did cause the pendant to mount. As for example.



If the pendants first descent were from A to E, the second from C to E; because the time of those two is the same, ( as *Galileus* hath demonstrated ), it follows that their veloci-

ties gain'd in descending must of necessity be in the proportion of the line A E to the line C E: therefore, their effects also must be proportionable. Let us then put the line E D in that proportion to the line C E, which C E hath to A E; and then the velocity gain'd in C E will carry the pendent up from E to D, in the same time in which the descent A E did carry it up the other way from E to C : wherefore, seeing that the times of its descent from A. to E, and from C to E, are equal; likewise the two vibrations from A to C, and from C to D will be done in equal times. But, that which made *Galileo* not see the force of the consequence was, that he did not acknowledge violent motion to be made in the same proportions, and for the same reasons, which are found in natural motion, and for the same reasons, which are found in natural motion : which we have above shew'd to be so, where we discoursed of the matter.

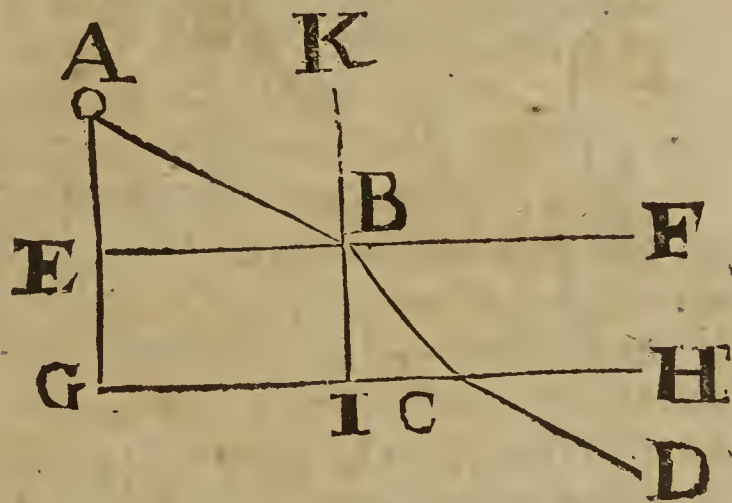
4.  
Refraction at  
the entrance  
into the refle-  
cent body is

That motion also which we call Refraction, and is manifest to sense only in light, ( though, peradventure hereafter, more diligent searchers of nature may likewise find in such other bodies as are called qualitie ; as in cold or heat, &c. ) is but a kind



kind of Reflexion. For, there being certain bodies, in which the passages are so well order'd with their resistences, that all the parts of them seem to permit light passe through them, and yet all seem to reflect it; when light passes through such bodies, it finds at the very entrance of them such resistences where it passes, as serve it for a reflecting body; and yet such a reflectent body, as hinders not the passage through, but only from being a straight line with the line incident. Wherefore the light must needs take a ply, as beaten from those parts, towards a line drawn from the illuminant falling perpendicularly upon the resisting superficies; and therefore is term'd by Mathematicians, to be refracted or broken towards the perpendicular. Now, at the very going out again of the light, the second superficies (if it be parallel to the former) must needs, upon a contrary cause, strike it the contrary way: which is which is termed from the perpendicular.

As for example, If the ray *A B*, lights upon the superficies *E B F*, and findes entrance: 'tis not now the superficies *E F* that resists or reflects it: but 'tis that part of the inside (as we may say of the Pore *B* towards *F*;



being a Physical body, not a Mathematical Point. The reflection therefore must be made, as if the reflectent body were *I B K*: but 'tis evident that if *A B* did strike upon *I K*, it would reflect towards *A G*. But, because we know not the inclination of the superficies *I K*, whether it be truly a perpendicular or no; therefore we cannot tell the quantity of the inclination which this reflection must make; but only we know it must be towards *A G*.

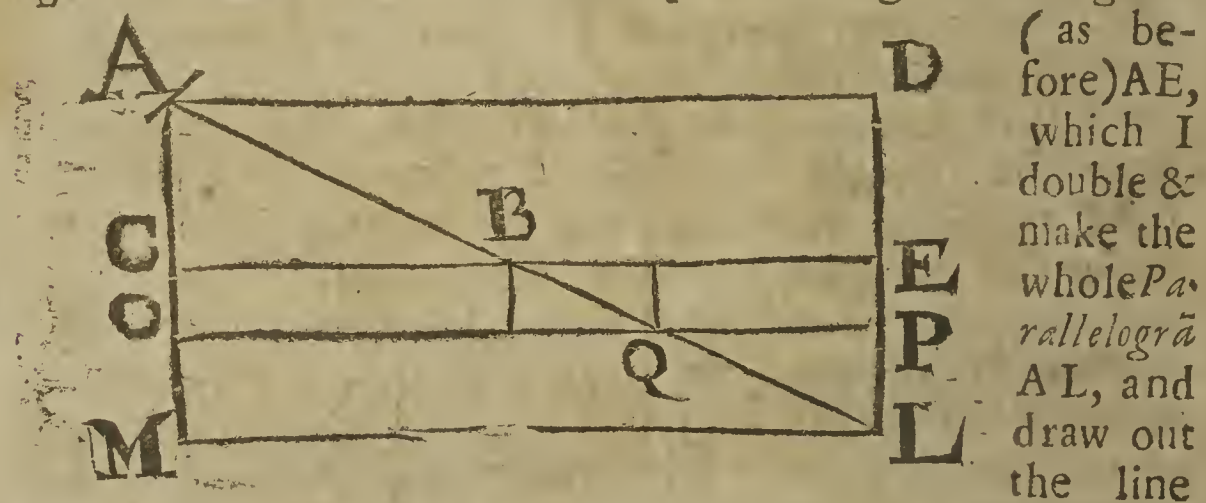
But, before we wade any deeper into this difficulty, we cannot omit a word of the manner of explicating Refraction, which Monsieur des Cartes uses; so witty a one as I am sorry it wants success. He therefore, following the demonstration above

5.  
A refutation  
of Monsieur des  
Cartes his ex-  
plication of  
refraction.



given of Reflection; supposes the *superficies* which a ball lights upon, to be a thin linen cloth; or some other such matter as will break cleanly, by the force of the ball striking smartly upon it. And because that *superficies* resists only one way, therefore he infers that the velocity of the ball is lessen'd only one way and not the other: so that the velocity of its motion, that way in which it finds no resistance, must be (after the balls passage through the linnen) in a greater proportion to the velocity which it has the other way were it finds resistance, then it was before. And therefore the ball will in less time arrive to its period on the one side then on the other: and consequently, lean towards that side to which the course wherein it findes no opposition carries it.

But, how much he is mistaken upon the whole matter a little figure will shew. Let us therefore put a *Rectangle Parallelogram*



AB, till it comes to L. Now, we must imagin, that CE is the cloth or passible *superficies*, which *Monsieur des Cartes* puts; and BL the line it would go in, if there were no resistance. Next, we must seek the perpendicular; which, according to our explication, is AC: for that falls from A the illuminant perpendicularly upon CE; although, some who defend *Monsieur des Cartes* seem to make another line the perpendicular, against the conception of all those that write of *Opticks*. But not to trouble our selves with terms, the question is, whether the ball that passes the cloth must (after its passage through) deflect from the line BL. (which it would have kept, had there been no resistance) towards E; or else deflect from that line towards C. And, both experience and reason assure us, that it must turn towards C: but *Monsieur des Cartes* saith towards E.

Which to shew how it is contrary to his own principle; Let us



us conceive the cloth  $CE$  to be of some thickness, and so draw the line  $OP$  to determine that thickness. And let us make from  $B$  upon  $AL$  another *Parallelogram*, like the *Parallelogram*  $AL$ , whose Diameter shall be  $BQ$ . And it must necessarily follow, that the motion from  $B$  to  $Q$ , if there were no resistance, were in the same proportion as from  $A$  to  $B$ . But the proportion of the motion as from  $A$  to  $B$  is the proportion of  $CB$  to  $CA$  that is, it goes in the same time, faster towards  $D$ , then towards  $M$ , in proportion which  $CB$  hath to  $CA$ . By which account, the resistance it has in the way towards  $D$  must also be greater, then the resistance it has in the way towards  $M$ , in the proportion which  $CB$  has to  $CA$ ; and therefore the more tardity must be in the way to  $D$ , and not in the way to  $M$ : and consequently, the declination must be from  $E$  wards, and to  $M$  wards. For, where there is most resistance, that way likewise must the tardity be greatest, and the declination must be from that way: but, which way the thickness, to be passed in the same time, is most, that way the resistance is greatest; and the thickness is clearly greater towards  $E$ , then towards  $M$ ; therefore, the resistance must be greatest towards  $E$ , and consequently, the declination from the line  $BL$  must be towards  $M$ , and not towards  $E$ .

But, the truth is, in his Doctrine, the ball would go in a straight line, as if there were no resistance; unless peradventure towards the contrary side of the cloth, at which it goes out into the free air. For, as the resistance of the cloth is greater in the way towards  $D$ , then in the way towards  $M$ , (because it passes a longer line in the same time, as also it did formerly in the air); so likewise is the force that moves it that way greater, then the force which moves it the other. And therefore, the same proportions that were in the motion, before it came to the resisting passage, will remain also in it, at least till, coming near the side at which it goes out, the resistance be weakned by the thinness of the resistant there: which, because it must needs happen on the side that has least thickness, the ball must consequently turn the other way, where it findes greatest yielding; and so at its getting out into the free air, it will bend from the greater resistance, in such manner as we have said above.

Neither do the examples, brought by *Monsieur des Cartes* and others in the maintenance of this Doctrine, any thing avail them:



An answer to  
the arguments  
brought in fa-  
vour of *Monsir*  
*des Cartes* his  
opinion.

them : for when a Canon Bullet shot into a River hurts the people on the other side ; 'tis not caused by refraction, but by reflection, as *Monsir des Cartes* himself acknowledges ; and therfor, has no force to prove any thing in refraction, whose Laws are divers from those of pure reflection.

And the same answer serves against the instance of a Musket bullet shot at a mark under water ; which perpetually lights higher then the mark, though exactly just aim'd at. For, we knowing that it is the nature of water, by sinking in one place to rise round about ; it must of necessity follow that the bullet, which in entring has press'd down the first parts of the water, has withal therby put others further off in a motion of rising : and therfore the bullet, in its going on, must meet with some water swelling upwards ; and from it receive a ply that way, which cannot fail of carrying it above the mark it was level'd at. And so we see this effect proceeds from reflection, or the bounding of the water, and not from refraction. Besides that, it may justly be suspected the shooter took his aim too high, by reason of the marks appearing in the water higher than in truth it is : unless such false aiming were duly prevented.

Neither is *Monsir des Cartes* his excuse to be admitted, when he saies that light goes otherwise than a ball would do ; because in a glass or water, the etherial substance, which he supposes to run through all bodies, is more efficaciously moved than in air : and therfore light must go faster in the glass than in the air, and so turn on that side of the straight line which is contrary to the side that the ball takes, because the ball goes not so swiftly. For, (not to dispute the verity of this proposition) the effect he pretends is impossible : for, if the etherial substance in the air, before the glass, be slowly moved, (the motion of which he calls *light*) ; 'tis impossible that the etherial substance in the glass or in the water should be more smartly moved than it. Well it may be less ; but without all doubt the impulse of the etherial substance in the Glass cannot be greater than its adequate cause ; which is the motion of the other parts that are in the air precedent to glass.

Again, after it is pass'd the glass, it should return to be a straight line with the line that it made in the air precedent to the glass ; in the subsequent air must take off just as much (and no more) as the glass did add : the contrary wherof experience shews us.

Thirdly,



Thirdly, in this explication it would always go one way in the air, and another way in the glass: whereas all experience testifies that, in a glass convex on both sides, it still goes in the air, after its going out, to the same side as it did in the glass; but more. And the like happens in glasses on both sides concave, Wherefore 'tis evident, that 'tis the *superficies* of the Glass that is the worker on both sides: and not the substance of the air on one side, and of the glass on the other.

And lastly, his answer no way solves our objection; which proves that the resistance both ways is proportionate to the force that moves; and, by consequence, that the thing moved must go straight. As we may imagine would happen, if a bullet were shot sloping through a green mud wall, in which there were many round sticks, so thin set that the bullet might pass with ease through them; for, as long as the bullet touched none of them (which expresses his case) it would go straight; but, if it touch'd any (which resembles ours, as by and by will apperar), it would glance according to the quality of the touch, and move from the stick in another line.

Some peradventure may answer for *Monsieur des Cartes*, that this subtile body, which he supposes to run through all things, is stiff and no ways pliable. But, that is so repugnant to the nature of rarity, and so many insuperable inconveniences follow out of it, as I cannot imagin he will own it; and therefore I will not spend any time in replying therto.

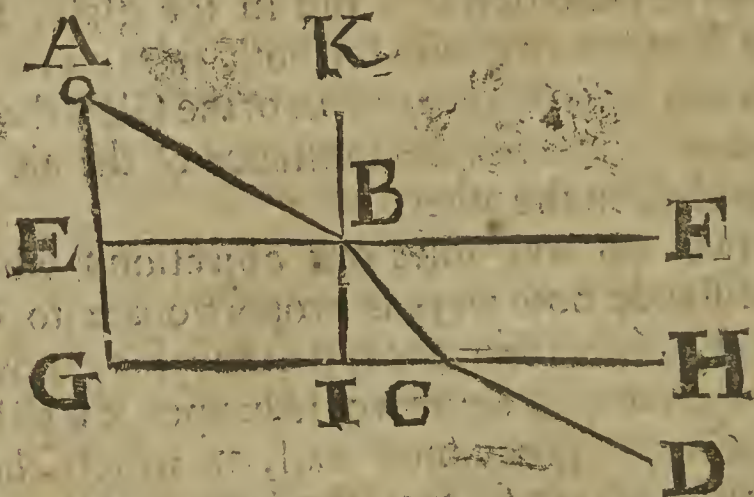
We must therefore seek some other cause of the refraction of light, which is made at the entrance of it into a *Diaphanous* body. Which is plainly (as we said before), because the ray, striking against the inside of a body it cannot penetrate, turns by reflection towards that side on, which the illuminant stands and if it findes clear passage through the whole resistant, it follows the course it first takes; if not, then 'tis lost by many reflections to and fro.

And that this Doctrine is true, the accidents or *Phaenomenas* evidently declare to us: for experience teaches that, upon a plain *superficies*, the refraction is made towards the perpendicular drawn from the illuminant to the *superficies*; as we have said. Now, at the going out (if the surfaces be parallels) we see that the ray turns from that perpendicular; which also is necessary; for, going through a pore bigger than it self, or at the least

7.  
The true cause  
of refraction  
of light, both  
at its entrance  
and at its go-  
ing out, from  
the reflecting  
body.



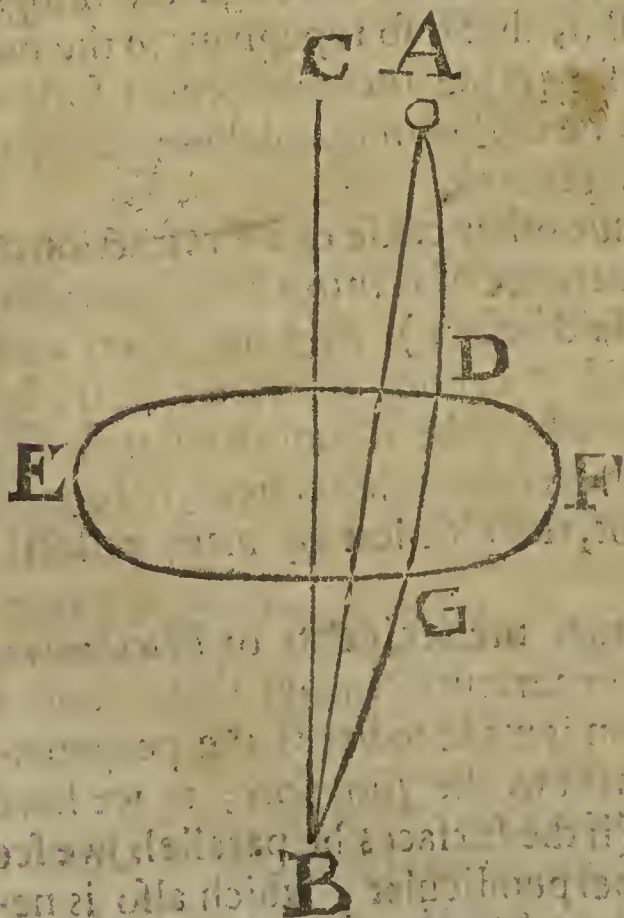
least as big, and finding it full of air, it must needs be crowded there now, in a crowd, he presses you most whom you press most upon: so then that side of the pore, which is next the light as it



passes, must press most upon it. But, the angle which is towards the perpendicular, to wit, the Angle BCI, is the lesser, and by consequence, the ray is nearer that side of the pore which

is toward I, then the other side of it which is towards H, wherefore it must take its ply from that side. But, that side strikes it from the perpendicular: therefore it must there retract from the perpendicular.

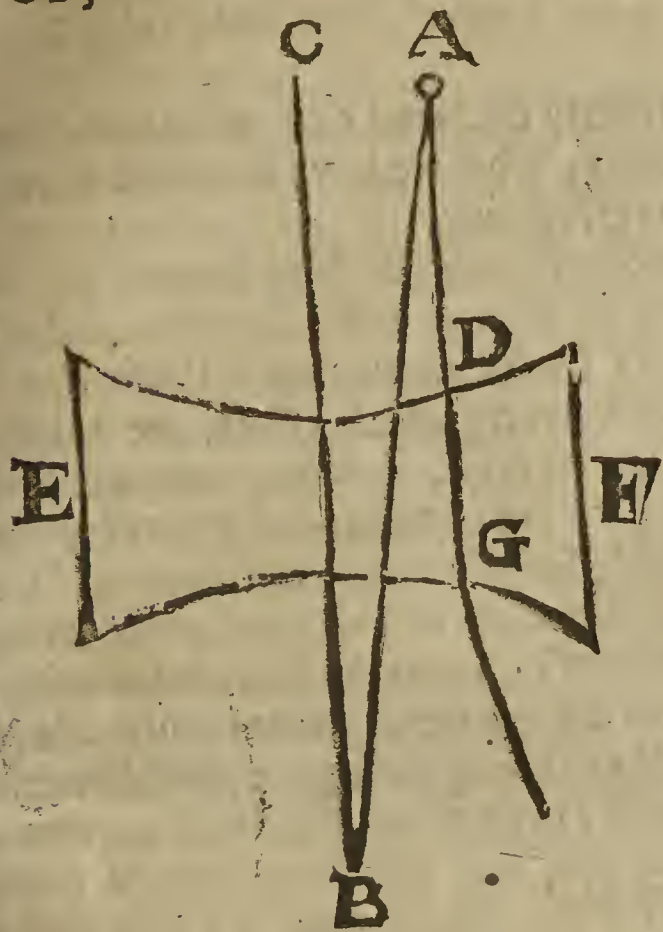
This very same doctrine, for the reason of refraction, is confirmed by what happens in crooked superficies. As if EF be a



Lens, or glass, on both sides convex; and CB the axis of it; AD the ray falling from the illuminant A; AB the perpendicular falling from the same illuminant A: it will be plain, by the former discourse, that the ray AD must, at the entry, be refracted towards AB, as being repulsed from that part of the inside of the pore D, which is towards F; because that side is most opposed to the ray. Now, the ray being once turn'd that way, when, at the end of its journey through the glass



glass, 'tis come to the other *superficies* E G F, it makes the lesser angle towards F : and therefore must it, by the rule given above, be refracted again, at its parting from the glass, towards the same perpendicular ; and it will meet somewhere with the axis C B ; all which experience shews us to be true.



And, taking a body of concave surfaces, we shall (according to this doctrine of ours) find the causes of refraction just contrary ; and accordingly, experience likewise shews us the effects to be so too. Therefore since experience agrees exactly with our rules, we cannot doubt but the principles upon which we go, are well laid.

But, because crooked surfaces may have many irregularities ; it will not be amiss to give a rule, by which all of

S.  
A general rule to know the nature of reflections and refractions in all sorts of surfaces.

them may be brought to a certainty. And this it is, that Reflections from crooked *superficieses* are equal to the reflections that are made from such plain *superficieses*, as are *tangents* to the crooked ones in that point from whence the reflections are made. Which Principle the Masters of *Opticks* take out of a Mathematicall supposition, of the Unity of the reflecting point in both the surfaces, the crooked and the plain. But, we take it out of the insensibility of the difference of so little a part in the two different surfaces, as serves to reflect a ray of light : For, where the difference is insensible in the causes, there likewise the difference is so little in the effects, as sense cannot judge of them ; which is as much as is requisite to our purpose. Now since, in the Mathematical supposition, the point where the reflection is made is indifferent to both the surfaces : it follows, that



that it imports not whether *superficies* you take to know the quality of reflection by. This principle then being settled, that the reflection must follow the nature of the tangent surfaces; and it being proved, that, in plain surfaces, it will happen as we have explicated; it follows, that, in any crooked *superficies*, of what Figure soever, the same also will happen.

Now, seeing we have formerly declared, that refractions are but a certain kind of reflexions; what we have said here of reflexions may be apply'd to refractions.

9.  
A body of greater parts and greater pores makes a greater refraction, than one of lesser parts and lesser pores.

But, there remains yet untouch'd one affection more of refractions; which is, that some *Diaphanous* bodies in their inward parts reflect more, than others (which is that we call *refraction*) as experience shews us. Concerning which effect, we are to consider, that *Diaphanous* bodies may, in their composition, have two differences: for, some are composed of greater parts and greater pores; others, of lesser parts and lesser pores. 'Tis true, there may be other combinations of pores and parts; yet by these two the rest may be esteem'd. As for the first combination, we see that, because the pores are greater, a greater multitude of parts of light may pass together through one pore; and, because the parts are greater, likewise a greater multitude of rays may reflect from the same part, and find the same passage quite throughout the *Diaphanous* body. On the contrary side, in the second combination, where both the pores and the parts of the *Diaphanous* body are little, the light must be but little that finds the same passage.

Now, that refraction is greater or lesser, happens two ways: for, 'tis either when one *Diaphanous* body reflects light at more angles, than another, and by consequence in a greater extent of the *superficies*; or else when one body reflects light from the same point of incidence, in a shorter line and a greater angle, than another does. In both these wayes 'tis apparent that a body, composed of greater parts and greater pores, exceeds bodies of the opposite kind: for, by reason that, in the first kind, more light may beat against one part, a body in which that happens will wake an appearance from a further part of its *superficies*: whereas, in a body of the other sort, the light that beats against one of the little parts of it will be so little, as  
'twill



\*will presently vanish. Again, because in the first, the part at the incidence is greater, the surface from which the reflection is made inwards, has more of a plain and straight *superficies*: and consequently reflects at a greater angle, than that whose *superficies* hath more of inclining.

But, we must not pass from this question, without looking a little into the nature of those bodies in which refraction is made: for, if they, as well as the immediate causes of refraction, likewise favour us; it will not a little advance the certainty of our determination. To this purpose we may call to mind, how experience shews us that great refractions are made in smoke and mists, and glasses, and thick-bodied waters; and *Monsir des Cartes* adds certain Oyls and Spirits or strong Waters.

10.  
A confirmation of the former doctrine, out of the nature of bodies that refract light.

Now, most of these, we see, are composed of little consistent bodies, swimming in another liquid body. As is plain in smoke and mists: for the little bubbles which rise in the water before they get out of it, and that are smoke, when they get into the air, assure us, that smoke is nothing else, but a company of little round bodies swimming in the air; and the round consistence of water upon herbs, leaves, & twigs, in a rind or dew, gives us also to understand, that a Mist is likewise a company of little round bodies, that sometimes stand, sometimes float in the air, as the wind drives them. Our very eyes bear witness to us, that the thicker sort of waters are full of little bodies; which is the cause of their not being clear.

As for Glass, the blowing of it convinces, that the little darts of fire, which pierce it every way, do naturally, in the melting of it, convert it into little round hollow bodies; which, in their cooling, must settle into parts of the like figure. Then, for Chrystal and other transparent stones which are found in cold places; it cannot be otherwise, but that, the nature of cold piercing into the main body, and contracting every little part in it self, this contraction must needs leave vacant pores between part and part. And, that such transparent stones as are made by heat have the like effect and property, may be judg'd out of what we see in Bricks and Tiles; which are left full of holes by the operation of the fire. And I have seen, in bones that have lain a long time in the Sun, a multitude of sensible little pores close to one another; as if they had been formerly stuck all over with



with subtile sharp needles, as close as they could be thrust in, by one another. The Chymical Oyles and Spirits, which *Mo: fir des Cartes* speaks of, are likely to be of the same composition; since such use to be extracted by violent fires: for a violent fire is made by the conjunction of many rayes together; and that must needs cause great pores in the body it works on; and the sticking nature of these spirits is capable of conserving them.

Out of all these observations it follows, that the bodies, in which greatest refractions happen are compounded (as we have said) of great parts, and great pores: and therefore, by only taking light to be such a body, as we have described it, where we treated of its nature, 'tis evident, the effect we have exprest must necessarily follow by way of reflection; and refraction is nothing else but a certain kind of reflection.

Which last assertion is likewise convinced out of this, that the same effects proceed from reflection, as from refraction; for, by reflection a thing may be seen greater, than it is, in a different place from the true one where it is; colours may be made by reflection, as also gloating light, and fire likewise; and peradventure all other effects which are caused by refraction, may as well as these, be perform'd by reflection. And therefore 'tis evident, they must be of the same nature; since children are the resemblances of their parents.

#### CHAP. XIV.

*Of the composition, qualities, and generation of mixed bodies.*

The connexion of this Chapter with the rest, and the Author's intent in it.

**H**AVING now declar'd the vertues by which Fire and Earth work upon one another, and upon the rest of the Elements; which is, by Light, and the motions we have discours'd of: Our task shall be in this Chapter, first, to observe what will result out of such action of theirs; and next, to search into the ways and manner of compassing and performing it. Which latter we shall the more easily attain to, when we first know the end that their operation levels at. In this pursuit we shall find, that the effect of the Elements combinations, by means of the motions that happen among them, is a long pedigree of compounded qualities and bodies: wherein the first combinations (like marriages) are the breeders of the next more-composed substances, and they again are the parents of others in greater variety;



variety; and so are multiplied without end: for, the further this work proceeds, the more subjects it makes for new business of the like kind.

To descend in particular to all these is impossible. And, to look further then the general heads of them, were superfluous and troublesome in this discourse; wherein I aim only at shewing what sorts of things in common, may be done by Bodies: that, if hereafter we meet with things of another nature and strain, we may be sure they are not the off-spring of bodies and quantity; which is the main scope of what I have design'd here. And, to do this with confidence & certainty requires of necessity this leisurely and orderly proceeding we have hitherto used, and shall continue to the end. For, walking thus softly, we have always one foot upon the ground; so as the other may be sure of firm footing before it settle: Whereas, they, that for more haste will leap over rugged passages and broken ground, when both their feet are in the air, cannot help themselves, but must light as chance throws them.

To this purpose, then, we may consider, that the qualities of bodies in common are of three sorts. For they are belonging, either to the Constitution of a compounded body, or else to the Operation of it; and the Operation of a body is of two kinds, one upon Other Bodies, the other upon Sense. The last of these three sorts of qualities shall be handled in a peculiar Chapter by themselves. Those of the second sort, whereby they work upon, Other bodies, have been partly declar'd in the former chapters, and will be further discours'd of in the rest of this first Treatise. So as that which remains for the present is, to fall upon the discourse of such qualities as concur to the Constitution of bodies: with an aim to discover, whether (or no) they may be effected by the several mixtures of Rarity and Density, in such sort as is already declared. To which end, we are to consider in what manner these two primary differences of bodies may be joyn'd together; and what effects such conjunction will produce.

As for their conjunction; to deliver the nature of it entirely, we must begin from the very root of it: and consider, how, the Universe, being finite (which *Mr. White* hath demonstrated, in the *Second Knot* of his *First Dialogue*), there cannot be an Infinite Number of Bodies in it; for *Geometricians* shew us, how the least

K

quantity

2.  
That there is a least size of bodies, And that this least size is found in fire.



quantity that is may be repeated so often, as would exceed any the greatest determinate quantity whatever. Out of which it follows, that, although all the other bodies of the world were no bigger then the least quantity that can be designed; yet they, being infinite in number, would be greater then the whole Universe that contains them. Therefore, of necessity there must be some least body, or rather, some least size of bodies. Which in compounded bodies is not to be expected; for, their least parts, being compounded, must needs include compounding parts less then themselves. We must then look for this least size of bodies in the Elements; which of all bodies are the simplest: And, among them, we must pitch upon that, wherein is greatest divisibility, & which consequently is divided into least parts; that is, Fire, So as, we may conclude that, among all the bodies in the world, that which of its own nature hath an aptitude to be least must be Fire.

3.  
The first conjunction of parts is in bodies of least size; and it is made by the force of Quantity.

Now, the least body of fire, be it never so little, is yet divisible into less. What is it then that makes it be one? To determine this, we must resort to the nature of Quantity; whose formal notion and essence is, To be divisible: which signifies, that many may be made of it. But, that of which many may be made is not yet many; out of this very reason, that many may be made of it. But, what is not many is one. Therefore what hath quantity, is, by mere having quantity, actually and formally as well one, as it hath the possibility of being made many, and consequently, the least body of fire, by having quantity, has those parts, which might be many, actually one. And this is the first conjunction of parts that is to be consider'd in the composition of bodies: which, though it be not an *actual* joyning of *actual* parts, yet is a *formal* conjunction of what *may be* many.

4.  
The second sort of conjunction is compactedness in simple Elements, and it proceeds from Density.

In the next place we may consider, how, seeing the least bodies that are be of fire, it must needs follow, that the least parts of the other Elements must be bigger then they: And consequently the possible parts of those least parts of the other Elements must have something to conserve them together, more then is found in fire. And this, because Elements are purely distinguish'd by rarity and density, is straight concluded to be density. And thus we have found, that, as quantity is the cause of the *possible* parts being one, so density is the cause of the like parts sticking together.



together : which appears in the very definition of it ; for, to be less divisible ( which is the notion of density ) speaks a resistance to division, or sticking together.

Now, let us examine how two parts of different Elements are joyn'd together, to make a compound. In this conjunction we find both the affects we have already touch'd: for two such parts must make one ; and moreover, they must have some resistance to divisibility. The first of these effects we have already assign'd to the nature of quantity. And, it being the formal effect of quantity, it cannot ( wherever it is found ) have any other formal cause then quantity : wherefore, either the two little parts of different Elements do not become one body ; or if they do, we must agree 'tis by the nature of quantity, which works as much in Heterogeneal parts as Homogeneal. And it must needs do so : because Rarity and Density ( which are the proper differences of Quantity ) cannot change the common nature of Quantity, their *Genus* ; which, by being so to them, must be univocally in them both. And this effect comes precisely from the pure notion of the *Genus* ; and consequently, must be seen as well in two parts of different natures, as in two parts of the same nature : but, in parts of the same nature, which once were two and afterwards become one, there can be no other reason why they are one, then the very same for which those parts that were never separated ( but that may be separated ) are likewise one : and this, most evidently, is the nature of quantity.

5.  
The third conjunction is of parts of different Elements ; and it proceeds from quantity and density together.

Experience seems to confirm thus much ; when, pouring water out of a basin, some of it will remain sticking to the sides of the metal. For if the quantity of the basin, and of the water, had not been one and the same by its own nature, the water ( considering the pliability of its parts ) would certainly have come all away and glided from the unevenness of the basin, by the attractive unity of its whole ; and would have preserv'd the unity of its quantity within it self, rather then, by sticking to the basin, have suffer'd division in its own quantity ; which we are sure was one, whiles the water was altogether in the basin. But that, both the basin and the water making but one quantity, and a division being unavoydable in that one quantity ; it was indifferent, in regard of the quantity consider'd singly



by it self, where this division should be made, whether in the parts of the basin, or in the parts of the water : and then, the other circumstances determin'd it, in that part of the water which was nearest to the joyning of it with the basin.

The second effect (which was, resistance to divisibility) we assign'd to density. And of that same cause must also depend the like effect, in this case of the sticking together of the two parts of different Elements, when they are joyn'd to one another, For, if the two parts, whereof one is dense the other rare, doe not exceed the quantity of some other part of one Homogeneal rare Element; for the dividing wherof such a determinate force, and no less, can suffice : then, seeing that the whole composed of these two parts is not so divisible, as the whole consisting of that one part ; the assign'd force will not be able to divide them. Wherefore 'tis plain, that if the rare part had been joyn'd to another rare part, instead of the dense one it is joyn'd to ; it had been more easily dividable from that, then now it is from the dense part : And by consequence, it stickes more closely to the dense part, then it would to another of its own nature.

6.  
The reason  
why liquid  
bodies, easily  
joyn together,  
and dry ones  
difficultly.

Out of what we have said, a step is made us to understand why soft and liquid bodies easily joyn and incorporate into one continued body; but hard and dry bodies so difficultly, as by experience we find to be true. Water with water, or wine either with other wine, or with water, so unites, that 'tis very hard to part them : but sand or stones cannot be made to stick together, without very great force and industry. The reasons whereof must necessarily depend of what we have said above. To wit, that two bodies cannot touch one another, without becoming one : and that, if two bodies of one degree of density do touch, they must stick together according to the force of that degree of density. Out of which two is manifestly infer'd, that, if two hard things should come to touch, they must needs be more difficultly separated then two liquid things. And consequently, they cannot come to touch, without as much difficulty, as that whereby they are made one.

7.  
That no two  
hard bodies  
can touch one  
another im-  
mediately.

But, to deduce this more particularly; let us consider, that all the little surfaces, by which one hard body may be conceiv'd to touch another (as for example, when a stone lies upon a stone), must of necessity be either plain, or concave, or convex. Now, if



if a plain *superficies* should be supposed to touch another plain one coming perpendicularly to it; it must of necessity be granted to touch it as soon in the middle as on the sides. Wherefore, if there were any air (as of necessity there must be) betwixt the two surfaces before they touch'd; it will follow, that the air, which was in the middle, must have fled quite out from between the two surfaces, as soon as any part of the surfaces touch, that is, as soon as the air which was between the utmost edges of the surfaces did fly out; and, by consequence, it must have moved in an instant.

But, if a plain surface be said to touch a convex surface; it touches it only by a line (as Mathematicians demonstrate) or a point. But, to touch by a line or a point is, in truth, not to touch by the form or motion of Quantity, (which requires divisibility in all that belongs to it;) and by consequence among bodies it is not-to-touch: and so, one such surface doth not touch the other.

Now, for a plain surface to touch a concave, every man sees is impossible. Likewise, for two convex surfaces to touch one another, they must be allow'd to touch either in a line or in a point which we have shew'd not to be a physical touching. And if a convex surface should be said to touch a concave, they must touch all at once, as we said of plain surfaces; and therefore the same impossibility will arise therein. So that 'tis evident, no two surfaces, moving perpendicularly towards one another, can come to touch one another; if neither of them yields, and changes its hew.

Now then, if it be supposed they come slidingly one over another in the same line; wherby, first, the very tips of the edges come to touch one another; and still as you shove the uppermost on forwards, and it slides over more of the nether surface, it gains to touch more of it: I say that, neither in this case, do they touch immediately one another. For, as soon as the two first parts should meet, if they did touch and there were no air between them, they must presently become one quantity or body, as we have declared; and must stick firmly together, according to their degree of density; and consequently, could not be moved on, without still breaking asunder at every impulse as much of the massie body, as were already made one by their touching.



And, if you should say they did not become one; and yet allow them to touch immediately one another, without having any air or fluid body between them: then, if you suppose them to move onwards upon these terms, they would be changed locally, without any intrinsecal change; which, in the book *De Mundo* (as we have formerly alledg'd) is demonstrated impossible.

There remains only a third way for two hard surfaces to come together, which is, that first they should rest sloping one upon another, and make an angle where they meet (as two lines that cut one another doe, in the point of their intersection); and so contain as it were a wedge of air between them: which wedge they should lessen by little and little, through their moving towards one another at their most distant edges (whiles the touching edges are like immoveable centers that the others turn upon); till at length they shut out all the air, and close together, like the two legs of a compass.

But neither is it possible that this way they should touch. For, after their first touch by one line, (which neither is, in effect, a touching, as we have shewed) no other parts of them can touch, though still they approach nearer and nearer; till their whole surfaces entirely touch at once: and therefore, the air must, in this case, leap out in an instant a greater space, then if the surfaces came perpendicularly to one another; for, here it must flie from one extremity to the other; whereas, in the former case, it was to go but from the middle to each side.

And thus 'tis evident, that no two bodies can arrive to touch one another; unless one of them at the least have a *superficies* pleyable to the *superficies* of the other: that is, unless one of them be soft, which is, to be liquid in some degree. Seeing then, that by touching, bodies become one; and liquidity is the cause and means whereby bodies arrive to touch: we may boldly conclude, that two liquid bodies most easily and readily become one; and, next to two such, a liquid and a hard body are soonest united; but, two hard ones most difficultly.

8.  
How mixed  
bodies are framed in general.

To proceed then with our reflections upon the composition of Bodies, and upon what results out of the joyning and mixture of their first differences, *Rarity* and *Density*: we see, how, if a liquid substance happens to touch a dry body, it sticks easily there-



thereto. Then consider, there may be so small a quantity of such a liquid body, as it may be almost impossible for any natural agent to divide it further into less parts; and suppose that such a liquid part is between two dry parts of a dense body, and, sticking to them both, becomes like a glew to hold them together: will it not follow, out of what we have said, that these two dense parts will be as hard to be severed from one another, as the small liquid part, by which they stick together, is to be divided? So that, when the viscuous ligaments, which, in a body hold together the dense parts, are so small and subtile, as no force we can apply can divide them; the adhesion of the parts must needs grow then inseparable. And therefore, we use to moisten dry bodies, to make them more easily be divided; whereas those that are over-moist are, of themselves, ready to fall in pieces. And thus you see how, in general, bodies are framed.

Out of which discourse, we may ballance the degrees of solidity in bodies. For, all bodies being composed of humide and dry parts, we may conceive either kind of those parts to be bigger or lesser, or to be more rare or more dense. Now, if the dry parts of any body be extreme little and dense, and the moist parts that joyn the dry ones together be very great and rare; then, that body will be very easie to be dissolv'd. But, if the moist parts, which glew together such extreme little and dense dry parts, be either lesser in bulk or not so rare; then the body composed of them will be in a stronger degree of consistence. And, if the moist parts which serve for this effect, be in an excess of littleness, and withal dense; then, the body they compose will be in the highest degree of consistence that nature can frame.

On the other side, if you glew together great dry parts, which are moderately dense & great, by the admixtion of humid parts that are of the least size in bulk, and dense withal; then the consistence will decrease from its height, by how much the parts are greater and the density less. But, if to dry parts of the greatest size, and in the greatest remissness of density, you add humid parts both very great and very rare; then the composed body will prove the most easily dissolveable of all that nature affords.

After this, casting our eyes a little further towards the composition

9.  
The cause of  
the several  
degrees of so-  
lidity in mix-  
ed bodies.

10.  
The rule  
whereto are



reduced all  
the several  
combinations  
of Elements  
in compound-  
ing of mixed  
bodies.

position of particular bodies; we shall find still greater mixtures the further we go: for, as the first and simplest compounded bodies are made of the four Elements, so, others are made of these, and again a third sort of them; and so on-wards, according as by motion, the parts of every one are broken in sunder, and mingled with others. Those of the first order must be of various tempers; according to the proportions of the Elements whereof they are immediatly made. As for example, such a proportion of Fire to the other three Elements will make one kind of simple body; and another proportion will make another kind: and so throughout, by various combinations and proportions, among all the Elements.

In the effecting of which work, it will not be amiss to look a little upon nature; and observe how she mingles, and tempers different bodies one with another, wherby she begets that great variety of creatures we see in the World, But, because the degrees of composition are infinite, according to the encrease of number, we will contain our selves within the common notions of excess in the four primary components: for, if we should descend once to specify any determinate proportions, we should endanger losing our selves in a wood of particular natures; which belong not to us at present to examin. Then, taking the four Elements as materials to work upon; let us first consider how they may be varied, that differing compositions may result out of their mixtures. I conceive that all the ways of varying the Elements, in this regard, may be reduced to the several sizes of Bigness of the Parts of each Element, that enter into the composition of any body; and to the Number of those Parts: for, certainly, no other can be imagin'd, unless it were variety of *Figure*.

But, *that* cannot be admitted to belong, in any constant manner, to those least particulars wherof bodies are framed: as if determinate figures were, in every degree of quantity, due to the natures of Elements, and therefore the Elements would conserve themselves in those figures, as well in their least atoms, as massive bulk. For, seeing how these little parts are shuffled together without any order; and that all liquids easily joyn, and take the figures which the dense ones give them; and that they again, jostling one another, crush themselves into new shapes,  
to



to which their mixture with the liquid ones makes them yield the more easily: tis impossible the elements should have any other natural figure in these their least parts, then such as chance gives them. But, that one part must be bigger then another, is evident: for, the nature of rarity and density gives it; the first of them causing divisibility into little parts, and the latter hindring it.

Having then settled in what manner the Elements may be varied, in the composition of bodies, let us now begin our mixture. In which, our ground to work upon must be Earth and Water. For, only these two are the *basis* of permanent bodies, that suffer our senses to take hold of them, and submit themselves to trial. Whereas, if we should make the predominant Element to be Air or Fire, and bring in the other two solid ones under their jurisdiction, only to make up the mixture; the compound resulting out of them would be either in continual consumption (as ordinary fire is), or else through too much subtlety, imperceptible to our eyes or touch; & therefore not a fit subject for us to discourse of; especially, since the other two Elements afford us enough to speculate on. Peradventure our Smell might take some cognisance of a body so composed, or the effect of it, taken in by respiration, might in time shew it self upon our health: but it concerns not us now to look so far; our design requires more maniable substances.

Of these then let *Water* be the first; and with it we will mingle the other three elements, in excess over one another, by turns, but stil all of them oversway'd by a predominant quantity of water: and then let us see what kind of bodies will result out of such proportions. First, if earth prevail above fire and air, and arrive next in proportion to the water: a body of such a composition must needs prove hardly liquid, and not easie to let its parts run a sunder; by reason of the great proportion of so dense a body as earth, that holds it together. Yet, some inclination it will have to fluidness, by reason the water is predominant over all; which also will make it be easily divisible, and give every little resistance to any hard thing that shall be apply'd to make way through it. In a word, this mixture makes the constitution of Mud, Dirt, Honey, Butter, and such like things where the main parts are great ones. And such are the parts of earth and water, in themselves,

II.  
Earth and water are the *Basis* of all permanent mixed bodies.

II.  
What kind of bodies those are, where water is the *Basis* and earth the predominant element over the other two.

Let



13.  
Of those bodies where, water being the Basis, air is the predominant Element

Let the next proportion of excess, in a watry compound be of air; which, when it prevails, incorporates it self chiefly with earth; for the other Elements would not so well retain it. Now, because its parts are subtile, (by reason of the rarity it hath), and sticking, (because of its humidity); it drives the earth and water likewise into lesser parts. The result of such a mixture is, that the parts of a body compounded by it are close, catching, flowing slowly, glibb; and generally it will burn, and be easily converted into flame.

Of this kind are those we call *Oily* or unctuous bodies; whose great parts are easily separated, that is, easily divisible in bulk, ) but the small ones very hardly. Next, the smallness and well-working of the parts, by means of the airs penetrating every dense one and sticking close to every one of them and, consequently, joyning them without any unevenness, causes that there can be no ruggedness in it; and therefore, 'tis glibb: in like manner as we see plaister or starch become smooth, when they are well wrought. Then, the humidity of it causes it to be catching; and the shortness of every part makes that, where it sticks, it is not easily parted thence. Now, the rarity of air, next to fire, admits it to be (of all the other Elements) most easily brought to the height of fire, by the operation of fire upon it: And therefore, oyls are the proper food of that Element. And accordingly we see, if a drop of oyl be spill'd upon a sheet of paper, and the paper set on fire at a corner; as the fire comes near the oyl, the oyl will disperse and spread it self upon the paper to a broader compass than it had, because the heat rarifies it: and so, in Oyl it self, the fire, rarifying the air, makes it penetrate the earthy parts adjoynd to it more then it did; and so subtilizes them, till they be reduced to such a height as they are within the power of fire to communicate its own nature to them: and thus, it turns them into fire, and carries them up in its flame.

14.  
What kind of bodies result, where water is the Basis, and fire the predominant Element.

But, if fire be predominant over earth and air in a watry compound; it makes the body, so proportion'd, to be subtile, rare, penetrative, hot in operation, light in weight, and subject to burn. Of this kind are all sorts of wines, and distil'd Spirits, commonly called strong waters or *Aquavites*; in Latine, *Aque-ardentes*.



*ardentes*. These will lose their virtues, meerly by remaining uncover'd in the air : for, fire doth not incorporate strongly with water ; but, if it find means, raises it self into the air. As we see in the smoke of boyling water, which is nothing else but little bodies of fire, that, entring into the water, rarifie some parts of it ; but have no inclination to stay there, and therefore, as fast as they can get out, fly away : but, the humide parts of the water which they have rarified ( being of a sticking nature ) joyn themselves to them, and ascend in the air, as high as the fiery atomes have strength to carry them ; which when it fails them, that smoke falls down in a dew, and so becomes water again as it was. All which one may easily discern, in a glasse-vessel of water set over the fire ; in which one may observe the fire come in at the bottome, and presently swim up to the top like a little bubble, and immediately rise from thence in smoke ; and that will at last convert it self into drops, and settle upon some solid substance thereabouts.

Of these fiery *spirits* some are so subtile, as of themselves they will vanish, and leave no residue of a body behind them : and *Alchymists* profess to make them so etherial and volatile, that, being pour'd out of a glass from some reasonable height, they shall never reach the ground ; but before they come thither, be so rarified by that little motion, as they shall grow invisible like the air, and dispersing themselves all about in it, fill the chamber with the smell of that body which can no longer be seen.

The last excess in watery bodies must be of water it self ; which is, when so little a proportion of any of the other is mingled with it, as is hardly perceptible. Out of this composition arise all those several sorts of juices or liquors, we commonly call *Waters* : which, by their mixture with the other three Elements, have peculiar properties beyond simple Elemental water. The general quality whereof we shall not need any further to express ; because, by what we have already said of water in common, they are sufficiently known.

In our next survey, we will take *Earth* for our ground to work upon, as hitherto we have done water : which, if in any body it be in the utmost excess beyond all the other three, then rocks and stones will grow out of it ; whose driness and hardness may

assure

15.  
Of those bodies, where water is in excess ; it alone being both the *Basis*, and the predominant Element.

16.  
Of those bodies where Earth alone is the *Basis*, and also the predominant in excess over the other three Elements.



assure us, that Earth sways in their composition, with the least allay that may be. Nor doth their lightness (in respect of some other earthy compositions) impeach this resolution: for, that proceeds from the greatness and multiplicity of pores, wherewith their driness causes them to abound; and hinders not, but that their real solid parts may be very heavy.

17.  
Of those bodies where Earth is the basis, and Water the predominant Element over the other two.

Now, if we mingle a considerable proportion of water with earth, so as to exceed the fire and air, but still inferiour to the earth; we shall produce metals; whose great weight, with their ductility and malleability, plainly tells us, that the smallest of waters gross parts, are the glew that holds the earthy dense ones together; such weight belonging to earth, and that easie changing of parts being most proper to water. *Quick-silver* (that is, the general matter wherof all the metals are immediately composed) gives us evidence hereof: for, fire works upon it, with the same effect as upon water. And the calcination of most of the metals proves, that fire can easily part and consume the glew by which they were closed and held together: which therefore must be rather of a watry then of an airy substance. Likewise the glibness of *Mercury*, and of melted metals, without catching or sticking to other substances, gives us to understand, that this great temper of a moist Element with earth is water, and not air; and that the watry parts are comprised, and as it were shut up within the earthy ones: for, air catches and sticks notably to all things it touches, and will not be imprisoned; the divisibility of it being exceeding great, though in never so short parts.

18.  
Of those bodies where, earth being the basis, air is the predominant.

Now, if air mingles it self with earth, and be predominant over water and fire; it makes such an oily and fat soil, as Husbandmen account their best mould; which, receiving a betterment from the Sun & temperate heat, assures us of the concurrence of the aire: for wherever such heat is, air cannot fail of accompanying, or being effected by it; and the richest of such earth (as pot-earth and marl) will, with much fire, grow more compacted, and stick closer together then it did; as we see in baking them into pots or fine bricks. Whereas, if water were the glew between the dense parts, fire would consume it and crumble them asunder; as it doth in those bodies it calcines. And, excess of fire will bring them to vitrification; which still con-



confirms that air abounds in them : for, it is the nature of air to stick so close, where once it is kneaded in, as it cannot be separated without extreme difficulty. And, to this purpose, the viscu-ous holding together of the parts of glass, when it is melted, shews evidently that air abounds in vitrified bodies.

The last mixture we are to meddle with is, of fire with earth; in an over-ruling proportion over air and water. And this, I conceive, produces those substāces, which we may term co-agulated juyces, and which the Latines call *succi concreti* : whose first origine seems to have been liquours, that have been afterwards dried by the force either of heat or cold. Of this nature are all kind of Salts, Niters, Sulfurs, and divers sorts of Bitumens. All which easily bewray the relicks and effects of fire left in them ; some more, some less, according to their degrees.

And thus we have, in general, deduced from their causes the complexions of those bodies, whereof the bulk of the world, subjected to our use, consists ; and which serve for the production and nourishment of living creatures, both animal and vegetable. Not so exactly (I confess) nor so particularly, as the matter in it self, or as a Treatise confined to that subject, would require : yet, sufficiently for our intent. In the performance whereof, if more accurate searchers of nature shall find that we have peradventure, been mistaken in the minute delivering of some particular bodies complexion, their very correction (I dare boldly say) will justifie our principal scope ; which is, to shew that all the great variety we see among bodies arises out of the commixion of the First Qualities, and of the Elements: for, they will not be able to correct us upon any other grounds then those we have laid.

As may easily be perceiv'd, if we cast a summary view upon the qualities of compounded bodies. All which we shall find to spring out of rarity and density, and to favour of their origine : for, the most manifest qualities of bodies may be reduced to certain pairs, opposite to one another. As namely, some are liquid and flowing, others are consistent ; some are soft, others hard ; some are fatty, viscuous, and smooth, others lean, gritty, and rough ; some gross, others subtile ; some tough, others brittle : and the like. Of which, the liquid, the soft, the fat, and the viscuous, are so manifestly derived from rarity ; that we need not

take

19.

Of those bodies where, earth being the basis, fire is the predominant.

20.

All the Second Qualities of mixed bodies arise from several combinations of the First Qualities; and are at last resolv'd into several degrees of rarity and density.



take any further pains to trace out their origine : and the like is of their contraries, from the contrary cause, to wit, of those bodies that are consistent, hard, lean, and gritty ; all which evidently spring from density. As for smoothness, we have already shew'd how that proceeds from an airy or oily nature ; and by consequence, from a certain degree of rarity : And therefore roughness ( the contrary of it ) must proceed from a proportionable degree of density. Toughness is also a kind of ductility, which we have reduced to watriness ; that is, to another degree of rarity ; and consequently brittleness must arise from the contrary degree of density. Lastly, grossness and subtilness consist in a difficulty or facility to be divided into small parts ; which appears to be nothing else, but a certain determination of rarity and density. And thus we see, how the several complexions of bodies are reduced to the four Elements that compound them : and the qualities of those bodies, to the two primary differences of quantitative things, by which the elements are diversified.

21.  
That in the  
Planets and  
Stars there is  
a like variety  
of mixed bo-  
dies caused by  
light, as here  
upon Earth.

And, out of this discourse, it will be evident, that these complexions and qualities, though in diverse degrees, must of necessity be found wherever there is any variation in bodies. For, seeing there can be no variation in bodies, but by rarity and density ; and that the pure degrees of rarity and density make heat, cold, moisture, and driness, and ( in a word ) the four Elements ; 'tis evident, that, wherever there is variety of bodies, there must be the four Elements ; though peradventure far unlike these mixed bodies which we call Elements. And again, because these Elements cannot consist without motion, and by motion they of necessity produce Mixed bodies, and forge out those Qualities which we come from explicating ; it must by like necessity follow, that wherever there is any variety of active and passive bodies, there mixed bodies likewise must reside of the same kinds, and be indued with qualities of the like natures, as those we have treated of ; though peradventure, such as are in other places of the world, remote from us, may be in a degree far different from ours.

Since then it cannot be denied, but that there must be notable variety of active and passive bodies, wherever there is light : neither can it be denied but that, in all those Great Bodies from  
which



which light is reflected to us, there must be a like variety of complexions and qualities, and of bodies temper'd by them, as we find here in the Orb we live in. Which *Systeme*, how different it is from that which *Aristotle* and the most of the *School* have deliver'd us; as well in the evidencies of the proofs for its being so, as in the position and model of it: I leave to the prudent Readers to consider and judge.

Out of what has been already said, 'tis not hard to discover in what manner the composition of bodies is made. In effecting which, the main hinge wheron that motion depends is fire or heat: as it likewise is in all other motions whatever. Now, because the composition of a mixed body proceeds, from the action of one simple body or element upon the others; it will not be amiss to declare, by some example, how this work passes for that purpose, let us examine how fire or heat works upon his fellows.

225  
In what manner the Elements work upon one another, in the position of mixed bodies: and in particular, fire is the most active.

By what we have formerly deliver'd, 'tis clear, that fire streaming out from its centre, and diffusing it self abroad, so as to fill the circumference of a larger circle; it must needs follow, that the beams of it are most condens'd and compacted together near the centre, and, the further they stream from the centre, the more thin and rarified they must grow: yet this is with such moderation, as we cannot any where discern that one beam doth not touch another; and therefore the distances must be very small. Now, let us suppose that fire happens to be in a viscuous and tenacious body; and then consider what will happen in this case: of one side, the fire spreads it self abroad; on the other side, the parts of the tenacious body being moist (as I have formerly determin'd), their edges on all hands will stick fast to the dry beams of the fire that pass between them. Then they, stretching wider and wider from one another, must needs draw with them the parts of that tenacious body which stick to them; and stretch them into a greater wideness or largeness then they enjoy'd before: from whence it follows that (seeing there is no other body near therabouts, but they two), either there must be a vacuity left, or else the tenacious body must hold and fill a greater space then it did before; and consequently, be more rare. Contrariwise, if any of the other elements be stronger then fire, the denser Elements break off from their continu'd stream the little



little parts of fire, which were gotten into their greater parts; and, sticking on all sides about them, so enclose them, that they have no more semblance of fire: and, if afterwards by any accident there comes a great compression, they force them, to lose their natural rarity, and to become some other Element. Thus it fares with fire, both in acting and suffering. And the same course, we have in both these regards expressed of it passes likewise in the rest of the Elements; to the proportion of their contrarieties.

Hence it follows that, when fire meets with humidity in any body, it divides and subtilises it, and disperses it, gently and in a kind of equal manner through the whole body it is in, (if the operation of it be a natural and a gentle one): and so drives it into other parts; which at the same time it prepares to receive it, by subtilising likewise those parts. And thus, moderate fire makes humour, in very small parts, to incorporate it self, in an even or uninformed manner, with the dry parts it meets with: which being done, whether the heat afterwards continues, or the cold succeeds in lieu of it, the effect must of necessity be, that the body thus compos'd be bound up and fastn'd; more or less, according to the proportion of the Matter 'tis made of, of the Agents that work upon it, and of the Time they employ about it. This is every day seen, in the ripening of fruits, and in other frequent works as well of art as of nature; and is so obvious and sensible to any reasonable observation, that 'tis needless to enlarge my self much upon this subject.

23.

A particular  
declaration,  
touching the  
generation of  
Metals.

Only, it will not be amiss, for examples sake, to consider the progress of it in the composing or augmenting of metals, or earths of divers sorts. First, heat (as we have said) draws humour out of all the bodies it works on: then, if the extracted humour be in quantity, and the steams of it happen to come together in some hollow place, fit to assemble them into greater parts; they are condens'd, and fall down in a liquid and running body. These streams being corporified, the body resulting out of them makes it self in the earth a channel to run in: and, if there be any loose parts in the channel, they mingle themselves with the running liquor; and though there be none such, yet in time liquor it self loosens the channel all about, and imbibes into its own substance the



the parts it raises. And thus, all of them, compacted together, roll along; till they tumble into some low place, out of which they cannot so easily get, to wander further. When they are thus settled, they the more easily receive into them and retain such heat, as is every where to be met withal, because it is diffused more or less through the earth. This heat, if it be sufficient, digests it into a solid body: the temper of cold likewise concurring in its measure to this effect. And, according to the variety of the substances wherof the first liquor was made, and which it afterwards drew along with it; the body that results out of them is diversified. In confirmation of all which, they that deal in Mines tell us, they use to find metalls oftentimes mingled with stones: as also coagulated juyces with both, and earths of divers natures with all three; and they with it, and one with another among themselves. And that, sometimes, they find the mines not yet consolidated and digested thoroughly into metal; when, by their experience knowing after how many years they will be ripe, they shut them up again till then.

Now, if the hollow place wherein the body stay'd (which at first was liquid and rolling) be not at once filled by it, but it takes up only part of it; and the same liquor continues afterwards to flow thither: then this body is augmented, and groweth bigger and bigger. And, though the liquors should come at several times, yet they become not therefore two several bodies, but both grow into one body: for, the wet parts of the adventitious liquor mollifie the sides of the body already baked; and, both of them being of a like temper and cognation, they easily stick and grow together.

Out of this discourse it follows evidently, that, in all sorts of compounded bodies whatever, there must of necessity be actually comprised sundry parts of divers natures: for otherwise, they would be but so many pure degrees of rarity and density; that is, they would be but so many pure Elements, and each of them have but one determinate virtue or operation.

## C H A P. X V.

*Of the dissolution of mixed bodies.*

**T**Hus much for composition of Bodies. Their dissolution is made three wayes; either by fire, or by water, or by some  
 L out

Why some bodies are brittle



and others  
rough or apt  
to withstand  
outward vio-  
lence, the first  
instrument to  
dissolve mixed  
bodies.

outward violence. We will begin with examining how this last is done. To which end we may consider, that, the unity of any body consisting in the connexion of its parts; 'tis evident, the force of motion, if it be exercised upon them, must of necessity separate them; as we see, in breaking, cutting, filing, drawing asunder, and the like.

All these motions, because they are done by gross bodies, require great parts to work upon, & are easily discern'd how they work: so that it is not difficult to find the reason why some hard bodies break easily, and others with much ado. The first of which are called brittle, the others tough. For, if you mark it, all breaking requires that bending should precede: which on the one side compresses the parts of the bended body, and condenses them into a lesser room than they possess'd before; and on the other side stretches them out, and makes them take up more place. This requires some fluid or moveable substance to be within the body; else it could not be done; for, without such help the parts could not remove. Therefore, such hard bodies as have most fluid parts in them, are most flexible, that is, are toughest: and those which have fewest, though they become thereby hardest to have impression made upon them, yet, if the force be able to do it, they rather yield to break than to bend; and thence are called brittle.

Out of this we may infer, that some bodies may be so suddenly bent, as that thereby they break asunder; whereas, if they were leisurely and gently dealt withal, they would take what play one desires. And likewise that there is no body (be it never so brittle and hard) but it will bend a little (and indeed more than one would expect), if it be wrought upon with time & dexterity: for, there is none but contains in it some liquid parts, more or less; even glass and brick. Upon which occasion I remember, how once, in a great storm of wind, I saw the high slender brick Chimneys of the Kings house at *S. James's* (one winter, when the Court lay there) bend from the wind like boughs, and shake exceedingly and totter. And, at other times I have seen some very high and pointy Spire Steeples do the like. And I have been assured the like of the whole pile of a high castle, standing in a gullet in the course of the winde, (namely the castle of *Wardour*), who have often seen it shake notably in a fierce wind.

The



The reason of all which may be deduced out of what we have said above. For, since the bending of a body makes the spirits or humours within it to sally forth; 'tis clear, if the violence which forces it be not so sudden, nor the motion it receives so quick, but that the moisture may oose gently out, the body will bend stil more and more, as their abience gives it leave. But, if the motion wrought in it be too quick, then the spirits, not having time allow'd them to go leisurely and gently out, force their prison, and break out with a violence, and so the body is snap'd in two.

Here peradventure some (remembering what we have said in another place, namely, that it is the shortness and littleness of the humid parts in a body which makes it stick together; and that this shortness may be in so high a degree, as nothing can come between the parts they glew together to divide them) may ask, how a very dense body of such a strain can be broken or divided? But the difficulty is not great: for since the humid parts, in whatever degree of shortness they be, must necessarily have stil some latitude; it cannot be doubted but there may be some force assign'd greater then their resistance can be. All the question is, how to apply it to work its effect upon so close a compacted body, in which peradventure the continuity of the humid parts that bind the others together may be so small, as no other body whatever (no, not fire) can go between them, so as to separate part from part. At the worst, it cannot be doubted, but that the force may be so apply'd at the outside of that body, as to make the parts of it press, and fight one against another; and at length, by multiplication of the force, constrain it to yield and suffer division. And this I conceive to be the condition of gold and some precious stones: in which the elements are united by such little parts, as nothing but a civil war within themselves (stir'd up by some subtile outward enemy, wherby they are made to tear their own bowels) could bring to passe their destruction.

But this way of dissolving such bodies more properly belongs to the next way of working upon them, by fire: yet the same is done, when some exterior violence, pressing upon those parts it touches, makes them cut a way betwixt their next neighbours; and so, continuing the force, divide the whole body. As, when



the chisel or even the hammer with beating breaks gold asunder: for, it is neither the chisel nor the hammer, that doth that effect immediately; but they make those parts they touch cut the others that they are forced upon. As, I remember, hap'ned to a Gentleman, that stood by me (in a Sea-fight I was in) with a coat of mail upon his body; when, a bullet coming against a bony part in him, made a great wound, and shatter'd all the bones near where it struck, and yet the coat of mail was whole: it seems the little links of the mail, yielding to the bullets force, made their way into the flesh and to the bone.

3.  
The several effects of fire, the second and chiefest instrument to dissolve compounded bodies.

But now 'tis time to come to the other two instruments of separation of bodies; Fire and water: and to examine how they dissolve compounds. Of these two, the way of working of fire is the easiest and most apparant to be discerned. We may readily observe how it proceeds, if we but set a piece of wood on fire; in which it makes little holes, as if with bodkins it pierced it. So that the manner of its operation in common being plain, we need but reflect a little upon the several particular degrees of it. Some bodies it seems not to touch; as clothes made of *Asbestos*; which are only purified by it. Others it melts, but consumes not; as gold. Others it turns into powder, suddenly dissolving their body; as lead, and such metalls as are calcined by pure fire. Others, again it separates into a greater number of differing parts; as into Spirits, Waters, Oyls, Salt, Earth and Glass: of which rank are all vegetables. And lastly, others it converts into pure fire; as strong Waters, or *Aquavites* (called *Aque ardent*es), and some pure Oyls: for the smoak that is made by their setting on fire, and peradventure their salt, is so little as is scarce discernable. These are, in sum, the divisions which fire makes upon bodies, according to their nature, and its due application to them: for, by the help and mediation of other things, it may peradventure work other effects.

4.  
The reason why some bodies are not dissolv'd by fire.

Now, to examine a little in particular, how the same fire, in differing subjects, produces such different effects: *Limus ut hic durescit, & hæc ut cera liquefcit, Uno eodemque igni;*

We will consider the nature of every one of the subjects, apart by it self. First for the *Asbestos* 'tis clear, it is of a very dry substance; so that, to look upon it when it is broken into very little pieces, they seem to be little bundles of short hairs, the



the liquidity within being so little as it affords the parts neither length nor breadth ; and therefore fire meets with little there that it can dilate. But, what it cannot dilate it cannot separate; nor carry away any thing of it, but what is accidentally adherent to the outsides of it: And so it seems only to pass through the pores, and cleanse the little thrids ; but brings no detriment at all to the substance of it. In this I speak only of an ordinary fire: for, I doubt not but such a one it might be, as would perfectly calcine it.

The next body we speak of is *Gold*. This abounds so much in liquidity, that it stickes to the fire, if duly apply'd ; but its humidity is so well united to its earthy parts , and so perfectly incorporated with them , as it cannot carry away one , without both : but both are too heavy a weight , for the little agile parts of fire to remove. Thus it is able to make Gold swell ; as we see in melting it ; in which, the Gold receives the fire into its bowels and retains it a long time with it : but, at its departure, it permits the fire to carry nothing away upon its wings ; as is apparant, by the Golds no whit decay of weight, after never so long fusion. And therefore, to have fire make any separation in Gold, requires the assistance of some other moist body; that, on the one side, may stick closely to the Gold, when the fire drives it into it ; and, on the other side, may be capable of dilatation, by the action of the fire upon it. As, in some sort, we see in Strong Waters made of Salts, (being a proper subject for the fire to dilate) ; which, by the assistance of fire, mingling themselves closely with little parts of the Gold, pull them away from their whole substance , and force them to bear them company in their journey upwards, in which multitudes of little parts of fire concur to press on and hasten them : and so, the weight of gold being at length overcome by these two powerful Agents ( whereof one supplies what the other wants ), the whole substance of the metal is, in little atoms, diffused through the whole body of the water. But, this is not truly a dissolution or separation of the substantial parts of Gold, one from another: 'tis only a corrosion, which brings it into a subtile powder, (when the water & salts are separated from it), much like what filing (though far smaller) or grinding of leaf gold upon a porphyre stone may reduce it into : for neither the

5.  
The reason  
why fire  
melts gold,  
but cannot  
consume it.



parts of the water nor of the fire, that make themselves a way into the body of the gold, are small and subtile enough to get between the parts that compose the essence of it; and therefore all they can attain to is, to divide it only in its quantity or bulk, not in the composition of its nature.

Yet, I intend not to deny, but this is possible to be arrived to; either by pure fire duly apply'd, or by some other assistance; as, peradventure, by some kind of *Mercury*; which, being of a nearer cognation to Metals than any other Liquor is, may happily have a more powerful ingression into gold, than any other body whatever; and being withal very subject to rarefaction, may (after it is inter'd) so perfectly penetrate the gold, as it may separate every least part of it, and so reduce it into an absolute *calx*. But, in this place, I explicate no more than what ordinarily passes; leaving the mysteries of this Art to those who profess it.

6.  
Why Lead is easily consumed and calcined by fire.

To go on, then, with what we have in hand. *Lead* hath abundance of water overmingled with its earth; as appears by its easie yielding to be bent any way, and by its quiet standing bent in the same position that the force which bowed it leaves it in. And therefore the liquid parts of Lead, are easily separated from its dry and earthy ones: and, when it is melted, the very shaking of it causes the gross parts to descend, and many liquid ones to flie away with the fire; so that suddenly it is thus converted into powder. But, this powder is gross in respect of other metals; unless this operation be often reiterated, or the fire more powerfully apply'd, then what is just enough to bring the body of the Lead into powder.

7.  
Why and how some bodies are divided by fire into spirits, waters, oyls, salts, and earth; & what those parts are.

The next consideration of bodies that fire works upon is, of such as it divides into Spirits, Salts, Oyls, Waters, or Phlegms, and Earth. Now, these are not pure and simple parts of the dissolved body; but new compounded bodies made of the first, by the operation of heat. As Smoak is not pure water, but water and fire together; and therefore becomes not water but by cooling, that is, by the fire flying away from it. So likewise those Spirits, Salts, Oyls, and the rest, are but degrees of things which fire makes of diverse parts of the dissolved body; by separating them one from another, and incorporating it self with them. And so they are all of them compounded of the four Element, and are further resolvable into them.

Yet



Yet, I intend not to say, that there are not originally in the body, before its dissolution, some loose parts which have the properties of these bodies that are made by the fire in the dissolving of it: For seeing that nature works by the like instruments as art uses, she must need, in her excesses and defects, produce like bodies to what art doth in dissolution; which operation of art is but a kind of excess in the progress of nature. But, my meaning is, that, in such dissolution, there are more of these parts made by the working of fire, then were in the body before.

Now, because this is the natural and most ordinary dissolution of things; let us see in particular how it is done. Suppose then that fire were, in a convenient manner, apply'd to a body that hath all sorts of parts in it; and, our own discourse will tell us, the first effect it works will be, that, as the subtile parts of fire divide and pass through that body, they will adhere to the most subtile parts in it: which being most agile and least bound and incorporated to the bowels of the body, and lying, as 'twere, loosely scatter'd in it, the fire will carry them away with it. These, will be the first that are separated from the main body: which being retain'd in a fit receiver, will, by the coldness of the circumdant air, grow outwardly cool themselves, and become first a dew upon the sides of the glass, and then, still as they grow cooler, condense more and more, till at length they fall down congeal'd into a palpable liquor; which is composed (as you see) of the hottest parts of the body, mingled with the fire that carried them out: and therefore this liquor is very inflammable, and easily turn'd into actual fire; as you see all Spirits and *aquæ ardentes* of vegetables are.

The hot and loose parts being extracted, and the fire continuing and encreasing, those that will follow next are such as, though they be not of themselves loose, yet are easiest to be made so; and are therefore most separable. These must be humide, and those little dry parts which are incorporated with the overflowing humide ones in them (for no parts that we can arrive to are of one pure simple nature, but all mixed and composed of the four Elements in some proportion) must be held together with such gross glew as the fire may easily penetrate and separate them. And then the humide parts divided into little atoms stick to the lesser ones of the fire: which, by their multitude



of number and velocity of motion, supplying what they want of them in bulk, carry them away with them. And thus these Phlegmatick parts flie up with the fire, and are afterwards congeal'd into an insipide water: which, if it have any savour 'tis because the first ardent spirits are not totally separated from it; but some few of them remain in it, and give some little life to the whole body of that otherwise flat liquor.

Now, those parts which the fire separates next from the remaining body, after the fiery and watry ones are carryed away, must be such as it can work upon: and therefore must abound in humidity. But, since they stir not till the watry ones are gone, 'tis evident, they are composed of many dry parts strongly incorporated, and very subtilly mixed with the moist ones; and that both of them are exceeding small, and so closely and finely knit together, that the fire hath much ado to get between, and cut the thrids that tie them together: and therefore they require a very great force of fire to carry them up. Now the composition of these shewes them to be Ærial: and (together with the fire that is mingled with them) they congeal into that consistence which we call Oyl.

Lastly, it cannot be otherwise but that the fire, in all this while of continual application to the body it thus anatomises, hath harden'd & as it were, rosted some parts into such greatness and driness as they will not flie, nor can be carried up with any moderate heat. But, great quantity of fire, being mingled with the subtiler parts of his baked earth, makes them very pungent and acrimonious in tast: so that they are of the nature of ordinary Salt, and so called; and, by the help of water, may easily be separated from the more gross parts, which then remain a dead and useles earth.

By this discourse 'tis apparent; that fire has been the instrument, which hath wrought all these parts of an entire body, into the forms they are in: for, whiles it carried away the fiery parts, it swel'd the watry ones; and, whiles it lifted up them, it digested the Ærial parts; and, whiles it drove up the Oyle, it baked the earth and salt. Again, all these retaining, for the most part, the proper nature of the substance from whence they are extracted; 'tis evident, that the substance is not dissolv'd, (for so the nature of the whole would be dissolv'd and quite destroy'd & extinguish'd in



in every part ) but that onely some parts, containing the whole substance, or rather the nature of the whole substance, in them, are separated from other parts that have likewise the same nature in them.

The third instrument for the separation and dissolution of bodies is Water, whose proper matter to work upon is Salt: and it serves to supply what the fire could not perform; which is the separation of the salt from the earth, in calcined bodies. All the other parts fire was able to sever; but, in these he hath so baked the little humidity he hath left in them with their much earth, as he cannot divide them any further: and so, though he incorporates himself with them, yet he can carry nothing away with him. If then pure water be put upon that chalk, the subtlest dry parts of it easily joyn to the supervenient moisture; and sticking close to it, draw it down to them. But, because they are the lighter, it happens to them as when a man in a boat pulls the land to him; that comes not to him, but he removes himself and his boat to it: so these ascend in the water, as they dissolve. And the water, more and more penetrating them, and, by addition of its parts, making the humidity, which glews their earthy parts together, greater and greater, makes a wider and wider separation between those little earthy parts; and so imbues the whole body of the water with them, into which they are dispersed in little atomes. Those that are of biggest bulk remain lowest in the water, and, in the same measure as their quantities dissolve into less and less, they ascend higher and higher; till at length the water is fully replenish'd with them, and they are diffused through the whole body of it: while the more gross and heavy earthy parts (having nothing in them to make a present combination between them and the water) fall down to the bottome, and settle under the water in dust.

In which, because earth alone predominates in a very great excess, we can expect no other virtue to be in it, but that which is proper to mere earth; to wit, driness and weight. Which ordinary Alchemists look not after; and therefore call it *Terra damnata*: but others find a fixing quality in it, by which they perform very admirable operations, Now, if you prove the impregnated water from the *Terra damnata*, and then evaporate

How water,  
the third in-  
strument to  
dissolve bo-  
dies, dissolves  
Calx into Salt,  
and so into  
*Terra damnata*,



porate it, you will find a pure white substance remaining: Which by its bulk shews it self to be very earthy, and, by its pricking and corrosive taste, will inform you much fire is in it; and, by its easie dissolution in a moist place, that water had a great share in the production of it. And thus the salts of bodies are made and extracted.

9.  
How water mingled with salt, becomes almost powerfull Agent to dissolve other bodies.

Now, as water dissolves salt, so, by the incorporation and virtue of that corrosive substance, it doth more then salt it self can do: for, having gotten acrimony and more weight, by the mixture and dissolution of salt in it, it makes it self away into solide bodies, even into metalls, as we see in brasse and iron, which are easily rusted by salt dissolving upon them. And, according as the salts are stronger, so this corrosive virtue encreases in them; even so much, as neither silver nor gold are free from their eating quality: But they, as well as the rest, are divided into most small parts, and made to swim in water; in such sort as we have explicated above, and wherof every ordinary Alchymist teaches the practise.

But this is not all: salts help as well to melt hard bodies and metalls, as to corrode them. For, some fusible salts flowing upon them by the heat of the fire, and others dissolv'd by the steam, of the metal that incorporates with them, as soon as they are in flux, mingle with the natural juice of the metals, and penetrate deeper, then without them the fire could do, and swell them and make them fit to run.

20.  
How putrefaction is caused

These are the principal ways of the two last instruments in dissolving of bodies; taking each of them by it self. But there remains one more of very great importance, as well in the works of nature as of art; in which, both the former are joyned and concur: and that is putrefaction. Whose way of working is, by gentle heat and moisture to wet and pierce the body it works upon; wherby 'tis made to swell: and the hot parts of it being loosen'd, they are at length drunk up and drown'd in the moist ones (from whence by fire they are easily separated, as we have already declared;) and those moist parts afterwards leaving it, the substance remains dry and falls in pieces, for want of the glew that held it together.



## CHAP. XVI.

*An explication of certain Maxims, touching the operations and qualities of bodies : and whether the Elements be found pure in any part of the World.*

Out of what we have determin'd, concerning the natural actions of bodies, in their making and destroying one another; 'tis easie to understand the right meaning of some terms, and the true reason of some maxims much used in the Schools. As first; when Philosophers attribute to all sorts of corporeal Agents a Sphere of Activity. The sense of that manner of expression, in fire, appears plainly, by what we have already declared of the nature and manner of operation of that Element.

What is the Sphere of Activity in corporeal Agents.

And in like manner, if we consider, how the force of cold consists in a compression of the body that is made cold; we may perceive that, if, in the cooled body, there be any subtile parts which can break forth from the rest, such compression wil make them do so. Especially, if the compression be of little parts of the compressed body within themselves, as well as of the outward bulk of the whole body round about. For, at first, the compression of such causes, in the body where they are, little holes or pores in the places they are compressed & driven from: which pores they filled up, when they were dilated at their own natural liberty; But, being thus forcibly shrunk up into less room, afterwards they squees again out of their croud all such very loose and subtile parts (residing till then with them) as can find their way out from among them. And these subtile parts, that thus are deliver'd from the colds compressions, get first into the pores that, we have shew'd, were made by this compression. But, they cannot long stay there: for, the atoms of advenient cold that obsess the compressed body, do likewise, with all their force, throng into those pores, and soon drive out the subtile guests they find there, because they are more in number, bigger in bulk, and more violent in their course than they. Who therefore must yield to them the little channels and capacities they formerly took up. Out of which they are thrust with such an impetuositie, that they spin from them with a vehemence, as quick-



Quick silver doth through leather, when, to purifie it or bring an *Amalgame* to a due consistence, it is strained through the sides of it.

Now these showrs or streams of atomes issuing from the compressed body are on all sides round about it, at exceeding little distances; because the pores, out of which they are driven, are so likewise. And consequently, there they remain round about besieging it, as though they would return to their original homes, as soon as the usurping strangers, that were too powerful for them, will give them leave. And, according to the multitude of them, and to the force with which they are driven out, the compass they take up round about the compressed body is greater or lesser. Which besieging atomes are not so soon carried away by any exterior and accidental causes, but they are supplied by new emanations succeeding them out of the said compressed body.

Now, this which we have declared, by the example of cold compressing a particular body, happens in all bodies wherever they be in the world. For, this being the unavoidable effect of heat and of cold, wherever they reside, (which are the active qualities, by whose means, not only fire and water, and the other two Elements, but all other mixed bodies composed of the Elements, have their activity); and they being in all bodies whatever (as we have proved above); it follows evidently, that there is not a body in the world but has about it self an orbe of emanations, of the same nature which that body is of. Within the compass of which orbe when any other body comes, that receives an immutation by the little atomes whereof that orbe is composed; the advenient body seems to be affected, and as it were, replenished with the qualities of the body from whence they issue: Which is then said to work upon the body, that imbibes the emanations that flow from it. And, because this orbe (regularly speaking) is in the form of a Sphere; the passive body is said to be within the Sphere of the others activity.

Secondly, when Philosophers pronounce, that No corporeal nature can *operari* in distans; that is, that no body can work upon another remote from it, without working first upon the body that lies between them, which must continue and place up the operation from the agent to the patient. The reason and truth of this maxime is, in our Philosophy, evident. For, we having shew'd

2.  
The reason  
why no body  
can work in  
distance.



shew'd, that action among bodies is performed, for the most part, by the emission of little parts out of one body into another; as also, that such little parts cannot stream from the body that is their fountain, and settle upon a remote body, without passing through the interjacent bodies, which must furnish them, as it were, with channels and pipes to convey them whither they are to go: it follows manifestly, that the active emissaries of the working body can never reach their distant mark, unless they be successively ferried over the *medium* that lies between them; in which they must needs leave impressions of their having been there, and so work upon it in their passe, and leave in it their qualities and complexions, as a payment for their wastage over.

But, peradventure some may contend, that these invisible Serjeants and workmen are too feeble and impotent, to perform those visible great effects we daily see: As, when fire, at the length, burns a board that has been a great while opposed to it, though it touch not the body of the fire; or when a loadstone draws to it a great weight of Iron that is distant from it.

To whom we shall reply, that, if he will not grant these subtile emanations from the agent body to be the immediate workers of these effects, he must allot that efficacy to the whole corpulency of all the Agent working in bulk, (for, besides the whole & the parts, there is no third thing to be consider'd in bodies, since they are constituted by quantity): But the whole cannot work, otherwise then by local motion; which in this case it cannot do, because, by the supposition, it is determin'd to keep its distance from the passive body, and not to move towards it: Therefore, this is impossible; whereas the other can appear but difficult at the worst, and therefore must be admitted, when no better and more intelligible solution can be found:

But, withal we must note, that it is not our intention to say, but it may, in some circumstances, happen that some particular action or effect may be wrought in a remote part or body; which shall not be the same in the intermediate body that lies between the agent and the patient, and conveys the agents working atomes to the others body. As for example, when tinder or *Naphtha* is, by fire, made to burn at a yard distance from it, when the interjacent air is but warm'd by that fire: Or, when the Sun, by means of a burning-glass or some other reflection, sets  
some

3.  
An objection  
answer'd against the  
manner of ex-  
plicating the  
former Axi-  
ome.



some bodies on fire; and yet only enlightens the glass and the air that are in the way. The reason of which is manifest to be the divers dispositions of the different subjects, in regard of the Agent: and therefore 'tis no wonder that diverse effects should be produced, according to those divers dispositions.

4  
Of reaction;  
and first, in  
pure local  
motion, that  
each Agent  
must suffer in  
acting and act  
in suffering.

A third position among Philosophers is, that *All bodies which work upon others, at the same time, suffer from those they work upon: and contrariwise, all bodies which suffer from others, at the same time, work back again upon them.* For the better understanding wherof, let us consider, that all action among bodies is, either purely local motion, or else local motion with certain particularities, which give it a particular name. As, when we express the local motion of little atomes of fire, or of earth, or water, upon and into other bodies, by the words of heating or cooling; and so of the like. Now, if the action be pure local motion, and consequently, the effect produced by that action be meerly change of place; we must call to mind, how two dense bodies, moving one against the other, each of them bear before them some little quantity of a rarer body immediately joyn'd to them: and consequently, these more rare bodies must be the first to feel the power of the dense bodies and receive impressions from their motions, each of them by the opposite rare body, which, like an *Huissier* goes before, to make way for his following Master that obliges him to this service.

Now, when these rare Ushers have struggled a while, like the first lightly armed Ranks of two Armies, in the interjacent Field between their main Battails, that follow them close at the heels; they must at the length yield, when they are overborn by a greater weight then they can sustain; and then they recoil back, as it were, to save themselves by getting in among the files of the dense bodies that drove them on. Which not opening to admit them, and yet they still flying violently from the mastering force that pursues them; they presse so hard upon what at the first pressed them on, as, notwithstanding their density and strength, they force them to retire back: for, unless they do so, they are not of the number of those that work upon one another. And, this retiring is either on both sides, or but of one side. If both; then 'tis evident how each of them is an Agent, and each of



of them a sufferer; each of them overcoming his opposite in such sort, as himself likewise receives blows and loss. But, if only one of the dense bodies be so shocked as to recoil back; then that only suffers in its body, and the other suffers only in its virtue, that is, in the air or other rare body it sends before it: which it drives with such a violence, that it masters and quells the opposition of the other body, before it can reach to shake the dense body, before which it runs. Yet that rare body must be pressed and broken in <sup>two,</sup> in some measure, by the encounter of the other, (which though never so weak yet makes some resistance); but much more when it comes to grapple with the dense body it felt: and so, between them, it is wounded and infeeble, like those souldiers that first enter a Breach in a Town, from whence when they have driven the enemy, they pursue him to the Cittadel, and force him from thence too; and so, how maimed so ever they prove, they make a free and easie way without resistance for the whole body of their army to follow them, and take quiet possession of that which cost them so much to win.

And thus we see how it may happen, that one of these moving bodies doth not suffer so much as to be stay'd in its journey; much less, to be driven back: And yet the other body, at the same time, work in some measure upon it, by working upon what is next to it; which recoiling against it, must needs make some impression upon it, since there can be no opposition but must have some effect. Now this impression or effect, though it be not perceptible by causing a contrary motion, yet it must needs infeeble the virtue of the conquering Agent, and deaden the celerity of its motion. And thus it is evident, that, in all pure local motions of corporeal Agents, every one of them must, in some proportion, suffer in acting: and in suffering must act.

And, what we have said of this kind of action may easily be apply'd to the other; where the effect of local motion is design'd by a particular name; as it is in the examples we gave of heating and cooling. And, in that, the proceeding will appear to be the very same as in this: For, if fire heats water, the water reacts again, either upon the fire and cools it, if it be immediate to it; or else upon the interjacent air, if it be at a distance from the fire. And so the air is in some measure cooled, by the cold atomes that issue from the water; whose compass or sphere

5.  
The former doctrine applied to other local motions design'd by particular names. And that *Swiffeths* argument is of no force against this way of doctrine.

of



of activity being lesser then the fire's, they cannot cool so far off as others can heat; but, where they arrive, they give their proportion of cold, in the very midst of the others army of fiery atomes, notwithstanding their multitude and violence.

According to which doctrine, our Countryman *Swisseth's* argument, that in the Schools is held insoluble, hath not so much as any semblance of the least difficult. For 'tis evident, that such atomes of fire and water, as we determine heat and cold to be, may pass and croud by one another into the subjects they are sent to, by divers little streams, without hindring one another (as we have declared of air and light); and each of them be receiv'd, in their own nature & temper, by the same subject; though sense can judge only according to which of them is predominant, and according to the proportion of its superiority.

Upon which occasion we cannot chuse but note, how the doctrine of qualities is not only unable to give account of the ordinary and plain effects of nature; but also uses to end in clear impossibilities and contradictions, if it be driven far: as this argument of *Swisseth* shews, and many others of the like nature.

6.  
Why some notions admit of intensification and remission; and others not.

A fourth position among Philosophers is, that *Some Notions* admit the denominations of *Intention and remission*, but that *others do not*. The reason of which we shall clearly see, if we but consider how, these terms of intention and remission do but express more or less of the thing that is said to be intended or remitted: for the nature of more and less implies a latitude and divisibility; and therefore cannot agree with the nature of such things as consist in an indivisible being. As for example, to be a whole or an equal cannot be sometimes more, sometimes less; for, they consist in such a rigorous indivisible being, that, if the least part imaginable be wanting, it is no longer a whole, & if there be the least excess between two things, they are no longer equal, but in some other proportion then of equality, in regard of one another.

And hence it is that *Aristotle* teaches us that Substance and the species of *Quantity* do not admit of intention and remission; but that *Quality* doth. For first, in Substance, we know that the signification of this word is, that which makes a thing be what it is; as is evident by our giving it for an answer to the question *what a thing is*. And therefore, if there were any divisibility in



in Substance, it would be in what the thing is; and consequently, every division following that divisibility, would make the thing another what, that is another thing: and so the Substance that's pretended to be changed by intension or remission, would not be divided, as is supposed; but would cease to be, and another substance would succeed in the room of it. Wherby you see that every mutation in Substance makes a new thing; and that *more* and *less* in *quiddity* cannot be pronounced of the same thing.

Likewise in *Quantity*, 'tis clear, that its *Specieses* consist in an indivisible. For, as in Numbers, ten Lions (for example) or ten Elephants are no more in regard of multitude, then ten Fleas or ten Motes in the Sun; and, if you add or take any thing from ten, it is no more ten, but some other number: so likewise in Continued extension, a span, an ell, an ounce, or any other measure whatever, ceaseth to be span, &c. if you add to it or diminish from it the least quantity imaginable. And peradventure, the same is also of Figures; as of a Sphere, a Cube, a Circle, a Square, &c. though they be in the rank of *Qualities*.

But, if we consider such *Qualities*, as Heat, Cold, Moisture, Driness, Softness, Hardness, Weight, Lightness, and the like; we shall find that they may be in any body, sometimes more, sometimes less (according as the excess of any Element or mixture is greater in it, at one time then at another): and yet the body, in which these qualities are intended or remitted, remain still with the same denomination. As, when Dirt continues still soft, though sometimes it be less soft, other whiles softer; and wax remains figurable, whether it be melted or congealed; and wood is still hot though it lose or gain some degrees of heat.

But such *intention* in any subject whatever hath its determinate limits, that it cannot pass; for when more of that quality which we say is intended (that is, more of the atoms of the active body) is brought into the body that suffers the intension, then its complexion can brook; it resigns its nature to their violence, and becomes a new thing, such an one as they are pleased to make it. As when wood, with extremity of heating (that is, with bringing into it so many atoms of fire, that the fire is wronger in it then its own nature) is converted into fire, smoak, water, and ashes; and nothing remains of the nature of wood.

But, before we end this Chapter, we may remember how, in the

M

close

That in every



part of our  
habitable  
world, all the  
four Elements  
are found  
pure in small  
atoms; but  
not in any  
great bulk.

of the Fourth, we remitted a question concerning the Existence of the Elements (that is, whether in any places of the world there were any pure elements, either in bulk or in little parts): as being not ready to resolve it, till we had declared the manner of working of bodies one upon another. Here then will be a fit place to determine that; out of what we have discoursed concerning the actions, wherby bodies are made and corrupted. For, considering the universal action of fire, that runs through all the bodies we have commerce withal, by reason of the Suns influence into them and operation upon them, with his light and beams, which reach far and near; and looking upon the effects we have shew'd follow thence: 'tis manifest, there cannot be any great quantity of any body whatever, in which fire is not intrinsically mixed. And, on the other side, we see that, where fire is once mixed, 'tis very hard to separate it totally from thence. Again, we see it is impossible that pure fire should be conserved, without being adjoyn'd to some other body: both because of its violent nativity, still streaming forth with a great impetuosity; as also because it is so easily overcome by any obdient body, when it is dilated. And therefore, we may safely conclude, that no simple Element can consist in any great quantity, in this course of nature we live in and take a survey of. Neither doth it appear, to what purpose nature should have placed any such storehouses of Simples; seeing she can make all needful complexions, by the dissolution of mixed bodies into other mixed bodies favouring of the nature of the Elements, without needing their purity to begin upon.

But, on the other side, it is as evident, that the Elements must remain pure in every compounded body, in such extreme small parts as we use to call atoms. For, if they did not, the variety of bodies would be nothing else, but so many degrees of rarity and density, or so many pure *Homogeneous* Elements; and not bodies composed of heterogeneous parts: and consequently would not be able to shew that variety of parts which we see in bodies, nor could produce the complicated effects which proceed from them. And accordingly, we are sure that the least parts, which our senses can arrive to discover, have many varieties in them: even so much that a whole living creature (whose organical parts must needs be of exceeding different natures) may be so little, as, to



our eyes, to seem indivisible ; we not distinguishing any difference of parts in it without the help of a multiplying glass: as, in the least kind of mites, and in worms pick'd out of childrens hands, we daily experience. So as it is evident that no sensible part can be unmingled. But then again, when we call to mind how we have shew'd that the qualities, which we find in bodies, result out of the composition and mixtion of the Elements ; we must needs conclude, that they must of necessity remain in their own essences in the mixed body : and so, out of the whole discourse, determine, that they are not there in any visible quantity, but in those least atoms that are too subtile for our senses to discern. Which position we do not understand so Metaphysically, as to say that their Substantial form remain actually in the mixed body ; but only that their accidental qualities are found in the compound: remitting that other question to Metaphysicians (those spiriual Anatomists) to decide.

## C H A P. X V I I.

*Of Rarefaction and Condensation, the two first motions of particular bodies.*

**O**ur intention in this discourse, concerning the natures and motions of bodies, aiming no further then at the discovery of what is or may be done by corporeal Agents ; thereby to determine what is the work of Immaterial and Spiritual Substances : it cannot be expected at our hands, that we should deliver here an entire and complete body of *Natural Philosophy* ; But only take so much of it in our way, as is needful to carry us, with truth and evidence, to our journeys end. It belongs not, then, to us to meddle with those sublime contemplations, which search into the nature of the vast Universe, and determine the unity and limitation of it ; and shew by what strings, and upon what pins and wheels and hinges, the whole World moves : and from thence ascend to an awful acknowledgment and humble admiration of the Primary Cause ; from whence, and of which, both the being of it, and the beginning of the first motion, and the continuance of all others proceed and depend.

Nor indeed would it be to any purpose, for any man to sail in

I.  
The Authors  
intent in this  
and the fol-  
lowing chap-  
ters :



Mr. Thomas  
White.

this Ocean, and begin a new voyage of navigation upon it: unless he were assured, he had ballast enough in his Ship, to make her sink deep into the water and carry her steddily through those unruly waves; and that he were furnish'd with skill & provition sufficient to go through, without either losing his course by steering after a wrong compass, or being forced back again with short and obscure relations of discoveries: since others, that went out before him, are return'd with a large account, to such as are able to understand and sum it up. Which surely our learned Countryman, and my best and most honoured Friend, and to whom of all men living I am most obliged (for to him I ow that little which I know; and what I have and shall set down in all this discourse, is but a few sparks kindled by me at his great fire), has both profoundly, and accutely, and in every regard judiciously performed, in his *Dialogues of the World*.

Our task then (in a lower strain, and more proportionate to so weak shoulders) is, to look no further then among those bodies we converse with. Of which having declared by what course and Engines Nature governs their common motions, that are found even in the Elements, and from thence are derived to all bodies composed of them; we intend now to consider such motions as accompany divers particular bodies, and are much admired by whoever understands not the the causes of them.

2.  
That bodies  
may be rarifi-  
ed, both by  
outward and  
inward heat;  
and how this  
is perform'd.

To begin from the easiest and most connexed with the actions of the Elements; the handsel of our labour will light upon the motions of Rarefaction and Condensation, as they are the passions of mixed bodies. And first, for Rarefaction, we may remember how it proceeds originally from fire, and depends of heat; as is declared in the former Chapter: and, wherever we find Rarefaction, we may be confident the body which suffers it is not without fire working upon it. From hence we may gather, that when the Air imprison'd in a baloon or bladder swells against what contains it, and stretches its case, and seeks to break out: this effect must proceed from fire or heat (though we see not the fire) working either within the very bowels of the air, or without; by pressing upon what contains it, and so making it self a way to it.

And, that this latter way is able to work this effect may be



be convinced, by the contrary effect from a contrary cause: for take a bladder stretch'd out to its greatest extent by air shut up within it, and hang it in a cold place; you will see it presently contract it self into a less room, and the bladder will grow wrinckled and become too big for the air within it. But, for immediate proof of this position, we see that the addition of a very smal degree of heat rarifies the air in a Weather-glass, (the air receiving the impression of heat sooner then water); and so makes it extend it self into a greater place: and consequently, it presses upon the water, and forces it down into a less room then formerly it possessed. And likewise we see Quicksilver and other liquors, if they be shut up in glasses close stop'd and set in sufficient heat (and a little is sufficient for this effect) will swell and fill their glasses; and at the last break them, rather then not find a way to give themselves more room: which is then grown too straight in the glass, by reason of the rarefaction of the liquors by the fire working upon them.

Now, again, that this effect may be wrought by the inward heat, that is inclosed in the bowels of the substance thus shut up, both reason and experience assure us. For, they teach us, that, if a body which is not extremely compacted; but that by its looseness is easily divisible into little parts (such a one as Wine or other spiritual liquors) be inclosed in a vessel; the little atoms that perpetually move up and down in every space of the whole World, making their way through every body, will set on work the little parts (in the Wine, for example) to play their game: so that the hot and light parts (if they be many), not enduring to be compressed and kept in by the heavie and cold ones, seek to break out with force; and, till they can free themselves from the dense ones that would imprison them, they carry them along with them, and make them swell out as well as themselves.

Now, if they be kept in by the vessel, so that they have not play enough; they drive the dense ones (like so many little hammers or wedges) against the sides of it, and at length break it, and so make themselves way to a larger room: But, if they have vent, the more fiery hot spirits fly away, and leave the other groffer parts quiet and at rest. On the other side, if the hot and light parts in a liquor be not many nor very active, and the vessel be so full that the parts have not free scope to remove



and make way for one another; there will not follow any great effect in this kind: as we see in Bottle Beer or Ale, that works little, unless there be some space left empty in the bottle. And again; if the vessel be very much too big for the liquor in it, the fiery parts find room, first to swell up the heavie ones, and at length to get out from them, though the vessel be close stopp'd; for they have scope enough to float up and down between the surface of the liquor, and the roof of the vessel.

And this is the reason that, if a little beer or small wine be left long in a great cask, be it never so close stop'd, it will in time grow dead. And then, if, at the opening of the bung (after the cask hath been long unstir'd), you hold a candle close to it, you shall, at the instant, see a flash of flame environing the vent. Which is no other thing, but the subtile spirits that, parting from the beer or wine, have left it dead; and, flying abroad as soon as they are permitted, are set on fire by the flame they meet with in their journey: as being more combustible (because more subtile) than that spirit of wine which is kept in form of liquor; and yet that likewise (though much grosser) is set on fire by the touch of flame: And this happens not only to Wine, and Beer, or Ale; but even to water. As dayly experience shews in the *East Indian* Ships, that, having been five or six yeers at Sea, when they open some of their casks of *Thames* Water in their return homewards (for they keep that water till the last, as being their best and most durable, and that grows lighter and purer, by the often purifyings through violent motions in storms, every one of which makes new gross and earthy parts fall down to the bottom, and other volatile ones ascend to the top); a flame is seen about their bungs, if a candle be near, as we said before of wine.

And to proceed, with confirming this doctrine by further experience, we dayly see that the little parts of heat, being agitated and brought into motion in any body, enter and pierce into other parts, and incorporate themselves with them, and set them on fire, if they be capable therof; as we see in wet Hay or Flax, laid together in great quantity. And, if they be not capable of taking fire, then they carry them with them to the outside; & when they can transport them no further, part flies away, & other part staies with



with them: as we see in new Beer or Ale; and in must of wine; in which a substance, usually call'd the mother, is wrought up to the top.

Which in wine wil at the last be converted into *Tartar*; when the spirits that are very volatile are flown away, and leave those parts, from whence they have evaporated, more gross and earthy then the others, where the grosser and subtiler parts continue still mixed. but in Beer, or rather in ale, this mother (which in them we call Barm) wil continue longer in the same consistence, and with the same qualities: for, the spirits of it are not so fiery that they must presently leave the body they have incorporated themselves with; nor are hot enough to bake it into a hard consistence. And therefore Bakers make use of it to raise their bread; which neither will it do, unless it be kept from cold: both which are evident signs that it works in force of heat; and consequently, that it continues still a hot and light substance.

And again we see that, after wine or beer hath wrought once, a violent motion wil make it work a new: As is daily seen in great lightnings, and in thunder, and by much rocking of them. For, such motion rarifies, and consequently heats them; partly by separating the little parts of the liquor, which were before as glew'd together, & therefore lay quietly, but now, by their pulling a sunder and the liquors growing thereby more loose then it was, they have freedom to play up and down: and partly by beating one part against another, which breaks and divides them into lesser atomes, and so brings some of them into the state of fires which, you may remember, is nothing else but a body brought into such a degree of littleness and rarity of its parts.

And this is the reason why such hard and dry bodies as have an unctuous substance in them are, by motion, either easily set on fire, or at least fire is easily gotten out of them. As happens in flints and divers other stones, which yields fire when they are stricken; and if presently after you smel to them, you shall perceive an odour of brimstone and burning: which is a certain signe that the motion converted into fire the natural Brimstone that was mingled with the Flint, & whose denser parts were grown cold, and so stuck to the stone. And, in like manner, the Ivywood, and divers others, as also the Indian Canes (which from thence are called *Firecanes*) being rub'd with some other



stick of the same nature, if they be first very dry, will of themselves set on fire : and the like will happen to Coach-wheels in the Summer, if they be overheated with motion.

3.  
Of the great  
effects of Rarefaction.

To conclude our discourse of Rarefaction, we may look a little into the power and efficacy of it; which is no where to be seen so clearly as in fire. And, as fire is the general cause of rarefaction, so is it of all bodies the most rarified : And therefore 'tis no marvel if its effects be the greatest that are in nature ; seeing 'tis the proper operation of the most active Element. The wonderful force of it we daily see in Thunder, in Guns, in Granado's, & in Mines; of which, continual experience as well as several Histories, witnesse little less then miracles. Leaving them to the remarks of curious persons, we wil only look into the way, by which so main effects proceed from causes that appear so slender.

4.  
The first manner of condensation, by heat

'Tis evident that fire (as we have said before ) dilates it self spherically ; as nature shews us manifestly in bubbles of boyling water, and Milk, and generally of such substances as are of a viscuous composition: for, those bubbles, being round, assure us that the cause which made them did equally dilate them from the *Centre* to all parts. Now then, remembring the infinite multiplication which is in fire, we may conceive that, when a grain of Gun-powder is turn'd into it, there are so many little bubbles of a viscuous substance, one backing another with great celerity, as there are parts of fire more then there were of Gun-powder. And, if we make a computation of the number and celerity of these bubbles, we shall find that although every one of them single seem to be of an inconsiderable force, yet the whole number of them together will exceed the resistance of the body move or broken by them : especially, if we note that, when hard substances have not time allow'd them to yield, they break the sooner. And then we shall not so much admire the extremities we see acted by these means.

Thus having look'd into the nature of Rarefaction, and trac'd the progress of it from the motion of the Sun & fire: in the next place we are to examine the nature of Condensation. And we shall oftentimes find it likewise an effect of the same cause otherwise working. For, there being two different ways to dry any wet thing, one, by taking away that juyce which makes a body liquid, the other, by putting more drought to the wet body,



dy, that it may imbibe the moisture; this latter way doth, as well as the former, condense a body: for, by the close sticking of wet to dry, the most part of condensation is effected in compounded bodies.

The first of these ways properly and immediately proceeds from heat. For heat, entering into a body, incorporates it self with the moist and viscuous parts it findes there; as purging medicines do with humour they work on: which when the stomach can no longer entertain, (by reason of their unruly motions in wrestling together), they are both ejected grappling with one another; and the place of their contention is thus, by the supervenience of a guest of a contrary nature (that will not stay long there), purged from the superabundance of the former ones that annoy'd it. Even so the fire, that is greedily drunk up by the watry and viscuous parts of a compounded body, and whose activity and restless nature will not endure to be long imprisoned there, quickly pierces quite through the body it enters into: and, after a while, streams out at an opposite side, as fast as it enters on the side next to it, and carries away with it those glewy parts it is incorporated with; and, by their absence, leaves the body they part from dryer then at the first it was.

Which course we may observe in Syrops that are boyl'd to a consistence, and in broths that are consumed to a jelly: over which, while they are making by the fire under them, you see a great steam; which is the watry parts that, being incorporated with fire, fly away in smoke. Likewise, when the sea-water is condens'd into salt, you see it is an effect of the Sun or fire, that exhales or boyls away all the palpable moisture. And so, when wet cloathes are hang'd, either in the Sun or at the fire, we see a smoake about the cloathes, and heat within them; which being all drawn out from them, they become dry.

And this deserves a particular note, that, although they should be not quite dry, when you take them from the fire; yet, by that time they are cool, they will be dry: for, the fire that is in them when removed from the main stock of fire, flying away, carries with it the moisture that was incorporated with it. And therefore while they were hot, that is, while the fire was in them, they must also be moist; because the fire and the moisture were grown,



Grown to be one body; and could not become through dry with that measure of fire, (for more would have dry'd them, even whiles they were hot) until they were also grown through cold. And in like manner, Syrups Hydromels, Gellies, and the like, grow much thicker after they are taken off from the fire, than they were upon the fire; and much of their humidity flies away with the fire, in their cooling, wherby they lessen much of their quantity, even after the outward fire hath ceased from working upon them.

5.  
The second  
manner of  
condensation,  
by cold.

Now, if the moist parts that remain after the drying be, by the heat, well incorporated in the dry parts; and so occasion the dry parts to stick close together; then, that body is condensed, and will (to the proportion of it) be heavier in a less bulk; as we see that Metals are heavier than Stones.

Although this effect be, in those examples, wrought by heat; yet, generally speaking, it is more proper to cold: which is the Second Way of drying a moist body. As when, in *Greenland*, the extreme cold freezes the Whalefishes Beer into Ice; so that the stewards divide it with Axes and Wedges, and deliver their portions of drinks to their ships company, and their Shallops gings, in their bare hands: but, in the innermost part of the Butt, they find some quantity of very strong liquor; not inferiour to moderate spirit of Wine. At first, before custome had made it familiar to them, they wonder'd that, every time they drew at the tap, when first it came from their ships to the shore, (for the heat of the hold would not let it freeze), no liquor would come, unless they new tap'd it with a longer gimlet: but, they thought that pains well recompen'd, by finding it in the tast to grow stronger and stronger; till, at last, their longest gimlets would bring nothing out, and yet the vessel not a quarter drawn off, which obliged them then to stave the Cask, that so they might make use of the substance that remain'd.

The reason of this is evident, That cold seeking to condense the beer, by mingling its dry and cold parts with it; those that would indure this mixture were imbibed and shrunk up by them: But the other rare and hot parts, that were squeez'd out by the dense ones which enter'd to congeal the beer, and were forced into the middle of the vessel (which was the furthest part for them to retire to, from their invironing enemies) conserv'd



serv'd themselves in their liquid form, in defiance of the assaulting cold; whiles their fellows, remaining by their departure more gross and earthy then they were before, yielded to the conquerour, they could not shift away from, and so were dry'd and condens'd in ice: which, when the Marriners thaw'd, they found like fair water, without any spirits in it or comforting heat to the stomack.

This manner of condensation, which we have described in the freezing of Beer, is the way most practis'd by nature; I mean, for immediate condensation (for condensation is, secondarily, wherever there is rarefaction, which we have determin'd to be an effect of heat.) And the course of it is, that a multitude of earthy and dry bodies, being driven against any liquor, easily divide it, by means of their density, their driness, and their littleness (all which in this case accompany one another, and are by us determin'd to be powerful dividers): and when they are gotten into it, they partly suck into their own pores the wet and diffused parts of the liquid body; and partly they make them (when themselves are full) stick fast to their dry sides, and become as a glew to hold themselves strongly together. And thus they dry up the liquor; and, by the natural pressing of gravity, contract it into a lesser room: No otherwise then when we force much wind or water into a bottle, and, by pressing it more and more, make it lye closser then of its own nature it would do; Or rather, as when ashes are mingled with water, both those substances stick so close to one another, that they take up less room then they did each apart.

This is the method of Frosts, and Snow, and Ice, both natural and artificial: For, in natural freezing, ordinarily the North or Northeast Wind, by its force, brings and drives into our liquors such earthy bodies, as it has gather'd from rocks cover'd with snow; which, being mix'd with the light vapours whereof the wind is made, easily find way into the liquors, and then they dry them into that consistence we call Ice. Which, in token of the wind it has in it, swims upon the water, and, in the vessel where it is made, rises higher then the water did wherof it is composed: and ordinarily it breaks from the sides of the vessel, so giving way to more wind to come in and freeze deeper and thicker.

But



3.  
That Ice is  
not water ra-  
rified, but  
condensed.

But because *Galileus* ( In his Discourses, *Intorno alle cose che stanno in su l' acqua*, pag. 4.) was of opinion, that Ice was water rarified, and not condensed; we must not pass over this verity, without maintaining it against the opposition of so powerful an adversary. His arguments are, first, that Ice takes up more place then the water did of which it was made; which is against the nature of condensation. Secondly, that, quantity for quantity, Ice is lighter then water; whereas things that are more dense are proportionally more heavie. And lastly, that Ice swims in water; whereas we have often taught, that the more dense descends in the more rare.

Now, to reply to these arguments, we say first, that We would gladly know how he did to measure the quantity of the Ice, with the quantity of the Water of which it was made: and then, when he hath shew'd it, and shew'd withall that Ice holds more place then water, we must tell him, that his experiment concludes nothing against our doctrine; because there is an addition of other bodies mingled with the water to make Ice of it (as we touch'd above), and therefore that compound may well take up a greater place then the water alone did, and yet be denser then it, and the water also be denser then it was.

And, that other bodies do come into the water and are mingled with it is evident, out of the exceeding coldness of the aire, or some very old wind; one of which two never misses to reign, whenever the water freezes: and both of them argue great store of little earthy dry bodies abounding in them, which, sweeping over all those that ly in the way and course, must of necessity be mixed with such as give them admittance; which water doth very easily. And accordingly we see that when, in the freezing of water, the Ice grows any thing deep, it either shrinks about the borders, or at least lies very loose; so as we cannot doubt but there is a free passage more of such subtile bodies to get still to the water, and freeze it deeper.

To his second argument, we ask? How he knows that Ice, quantity for quantity, is lighter then water? For though, of a Sponge that is full of water, it be easie to know what the sponge weighs, and what the water that was soaked into it, because we can part the one of them from the other, and keep each apart to examine their weights; yet, to do the like between Ice and water,



water, if Ice be throughout full of air (as of necessity it must be) we believe impossible. And therefore it may be lighter in the bulk then water, by reason of the great pores caus'd in it, through the shrinking up of the parts of water together (which pores must then necessarily be fill'd with air); and yet every part by it self (in which no air is) be heavier then so much water.

And by this it appears that his last argument (grounded upon the the swimming of Ice in water) has no more force, then if he would prove that an iron or earthen dish were lighter, and consequently more rare, then water, because it swims upon it; which is an effect of the airs being contain'd in the belly of it (as it is in Ice), not a sign of the metals being more rare then water.

Wheras, on the contrary side, the proof is positive and clear for us: For, it cannot be denied, but the mingling of the water with other bodies more dense then it must of necessity make the compound, & also the water it self, become more dense then it was alone. And accordingly we see, that Ice half thaw'd (for then much of the air is driven out, and the water begins to fill the pores wherein the air resided before) sinks to the bottom: as an Iron dish with holes in it (wherby the water might get into it) would do. And besides, we see that water is more *Diaphanous* then Ice, and Ice more consistent then water. Therefore I hope we shall be excused, if, in this particular, we be of a contrary opinion to this great personage.

But, to return to the thrid of our discourse. The same that passes here before us, passes also in the Sky with Snow, Hail, Rain, & Wind. Which that we may the better understand, let us consider how *Winds* are made: for they have a main influence into all the rest. When the Sun, by some particular occurrent, raises great multitudes of Atoms from some one place, and they, either by the attraction of the Sun or some other occasion, take their course a certain way; this motion of those atoms we call a wind: which, according to the continuance of the matter from whence these atoms rise, endures a longer or a shorter time, and goes a farther or a shorter way; like a river, or rather like those eruptions of waters, which, in the Northern parts of *England*, they call *Gypsies*, which break out at uncertain times, and upon uncertain causes, and flow likewise with

7.  
How wind,  
snow, and hail  
are made; and  
wind by rain  
allayed.



an uncertain duration. So these winds, being composed of bodies in a determinate proportion heavier then the air, run their course, from their height to the ground; where they are supported (as water is by the floor of its channel) whiles they perform their career: that is, till they be wasted, either by the drawing of the Sun, or by their sticking and incorporating into grosser bodies.

Some of these winds, according to the complexion of the body out of which they are extracted, are dry; as those which come from barren mountains cover'd with snow: others are moist; as those that come out of marishy or watry places: others have other qualities, as of heat, or cold, of wholesomeness, or unwholesomeness, and the like; partly from the source, and partly from the bodies they are mingled within their way.

Such then being the nature and origine of wind, if a cold one meet in the air with that moist body wherof otherwise rain would have been made, it changes that moist body into Snow or into Hail; if a dry wind meet with a wet body, it makes it more dry, and so hinders the rain that was likely to be: but, if the wet body overcome the dry wind, it brings the wind down along with it; as we see when a shewre of rain allays a great wind.

And that all this is so, experience will in some particulars instruct us, as well as reason, from whence the rest may be evidently infer'd, For we see that those, who, in imitation of nature, would convert water into Ice, take snow or ice & mingle it with some active dry body, that may force the cold parts of the snow from it: and then they set the water (in some fit vessel) in the way that those little bodies are to take; which, by that means entering into it, strait incorporate themselves therewith, and of a sudden convert it into ice. Which process you may easily try, by mingling *Salt Armoniack* with snow; but, much more powerfully, by setting the snow over the fire, whiles the glass of water to be congealed stands in it, after the manner of an egg in salt. And thus fire it self, though it be the enemy & destroyer of all cold, is made the instrument of freezing. And the same reason holds in the cooling of wine with snow or ice, when, after it has been a competent time in the snow, they, whose charge it is, use to give the vessel that contains the wine three or four turns in the snow; so to mingle through the whole body of the wine the cold



cold receiv'd first but in the outward parts of it, and, by pressing, too make that without to have a more forcible ingression.

But, the whole doctrine of *Meteors* is so amply, so ingeniously, and so exactly perform'd, by that never-enough-praised Gentleman, *Monsieur Des Cartes*, in his Meteorological discourses; as I should wrong my self and my Reader, if I dwell any longer upon this subject. And whose Physicall discourses, had they been divulged before I had entred upon this work, I am perswaded would have excused the greatest part of my pains in delivering the nature of bodies.

It were a fault to pass from treating of Condensation, without noting so ordinary an effect of it, as is the joyning together parts of the same body, or of divers bodies. In which we see, for the most part, that the solide bodies which are to be joyn'd together are, first either heated or moistned, that is, they are rarified: and then they are left to cold air or other cold bodies, to thicken and condense (as above we mentioned of Syrups and Jellies) and so they are brought to stick firmly together. In like manner we see that, when two metals are heated till they be almost brought to running, and then are pressed together by the hammer, they become one continued body. The like we see in glasse, the like in wax, and in divers other things. On the contrary side, when a broken stone is to be pieced together, the pieces of it must be wetted, and the cement must be likewise moistned; and then joyning them aptly, and drying them, they stick fast together. Grew is moistned, that it may, by drying afterwards, hold pieces of wood together. And the Spectacle-makers have a composition, which must be both heated and moistned, to joyn to handles of wood the glasses they are to grind. And broken glasses are cemented with cheese and chalk, or with garlick.

All these effects, our sense evidently shews us, arise out of condensation; but, to our reason it belongs to examine particularly by what steps they are perform'd. First, then, we know that heat subtilizes the little bodies which are in the pores of the heated body; and partly also it opens the pores of the body it self, if it be of a nature that permits it: as it seems those bodies are, which by heat are mollified or are liquofactable. Again, we know that moisture is more subtile to enter into small creeks, then

8.

How parts of the same or divers bodies are joyned more strongly together by condensation.



then dry bodies are; especially when it is pressed: for then it will be divided into very little parts, and will fill up every little chink; and nevertheless, if it be of a gross and viscuous nature, all the parts of it will stick together. Out of these two properties we have, that, since every body has a kind of orb of its own exhalations or vapours round about it self (as is before declared); the vapours which are about one of the bodies will more strongly and solidly (that is, in more abundant and greater parts) enter into the pores of the other body against which it is pressed, when they are opened and dilated: and thus they becoming common to both bodies, by flowing from the one, and streaming into the other, and sticking to them both, will make them stick to one another. And then, as they grow cold & dry, these little parts shrink on both sides, and, by their shrinking, draw the bodies together; and withal leave greater pores, by their being compressed together, then were there when by heat and moisture they were dilated: into which pores the circumstant cold parts enter, and thereby, as it were, wedge in the others, and consequently make them hold firmly together the bodies which they joyn.

But, if art or nature should apply to this juncture any liquor or vapour, which had the nature and power to insinuate it self more efficaciously to one of these bodies, then the glew which was between them did; of necessity in this case these bodies must fall in pieces. And so it happens in the separation of metals by corrosive waters; as also in the precipitation of metals or salts, when they are dissolv'd into such corrosive waters, by means of other metals or salts of a different nature: in both which cases, the entrance of a latter body, that penetrates more strongly, and unites it self to one of the joyn'd bodies but not to the other, tears them asunder, and that which the piercing body rejects falls into little pieces; and, if formerly it were joyn'd with the liquor, 'tis then precipitated down from it in a dust.

9.  
Vacuities cannot be the reason why water, impregnated to the full with one kind of salt, will notwithstanding receive more of another.

Out of which discourse we may resolve the question of that learned and ingenious man, *Petrus Gassendus*; who, by experience found, that water, impregnated to fulness with ordinary salt, would yet receive a quantity of other salt, and, when it would imbibe no more of that would nevertheless take into it a proportion of a third, and so of several kinds of salts one af-

ter



ter another : which effect he attributed to Vacuities or porous spaces of divers figures, that he conceived to be in the water ; wherof some were fit for the figure of one salt, and some for the figure of another. Very ingeniously ; yet, if I miss not my mark, most assuredly he hath missed his.

For, first, how could he attribute divers sorts of Vacuities to water, without giving it divers figures ? And this would be against his own discourse, by which every body should have one determinate natural figure.

Secondly, I would ask him, if he measured his water after every salting ? and, if he did, whether he did not find the quantity greater, then before that salt was dissolv'd in it ? Which if he did, (as without doubt he must), then he might safely conclude that his salts were not receiv'd in vacuities ; but that the very substance of the water gave them place, and so encreas'd by the receiving them.

Thirdly, seeing that, in his doctrine, every substance has a particular figure ; we must allow a strange multitude of different shapes of vacuities to be naturally in water, if we will have every different substance wherewith it may be impregnated ( by making decoctions, extractions, solutions, and the like ), to find a fit vacancy in the water to lodg it self in. What a difform net, with a strange variety of meshes, would this be ? And indeed, how extremely uncapable must it be of the quantity of every various kind of vacancy that, you will find, must be in it ; if in the dissolution of every particular substance, you calculate the proportion between it and the water that dissolveth it, and then multiply it according to the number of several kinds of substances that may be dissolved in water ? By this proceeding, you will find the vacuities to exceed infinitely the whole body of the water ; even so much that it could not afford subtile thrids enough to hold it self together.

Fourthly, if this doctrine were true, it would never happen that one body, or salt, should precipitate down to the bottom of the water, by the solution of another in it ; which, every Alchymist knows, never fails in due circumstances : for, seeing that the body which precipitates, and the other which remains dissolv'd in the water, are of different figures, and therefore require different vacuities ; they might both of them have kept their places



in the water, without thrusting one another out of it.

Lastly, this doctrine gives no account, why one part of salt is separated from another, by being put in the water; and why the parts are there kept so separated: which is the whole effect of that motion we call dissolution.

10.  
The true reason of the former effect.

The true reason therefore of this effect is (as I conceive), that one salt makes the water apt to receive another: for, the lighter salt, being incorporated with the water, makes the water more proper to stick to an heavier, and, by dividing the small parts of it, to bear them up, that otherwise would have sunk in it. The truth and reason of which will appear more plain; if at every joynt we observe the particular steps of every salts solution. As soon as you put the first salt into the water, it falls down presently to the bottome of it; and as the water by its humidity pierces by degrees the little joynts of this salt, so the small parts of it are by little and little separated from one another, and united to parts of water. And so, infusing more and more salt, this progress will continue; till every part of water is incorporated with some part of salt: and then, the water can no longer work of it self, but in conjunction to the salt with which it is united. After which, if more salt of the same kind be put into the water, that water so impregnated will not be able to divide it; because it has not any so subtile parts left, as are able to enter between the joynts of a salt so closely compacted: but may be compared to that salt, as a thing of equal driness with it; and therefore is unapt to moisten and pierce it.

But, if you put into this compound of salt and water another kind of salt, that is of a stronger and drier nature than the former and whose parts are more grossly united; then, the first salt dissolv'd in the water will be able to get in betwixt the joynts of the grosser salt, and divide it into little parts: and will incorporate his already-composed parts of salt and water into a decompound of two salts and water; till all his parts be anew impregnated with second grosser salt, as before, the pure water was with the first subtile salt. And so it will proceed on, if proportionate bodies be joyn'd; till the dissolving composition grow into a thick body.

To which discourse we may add, that, when the water is so fully impregnated with the first salt, as it will receive no more,  
re-



remaining in the temper 'tis in; yet, if it be heated, it will then afresh dissolve more of the same kind. Which shews, that the reason of its giving over to dissolve is, for want of having the water divided into parts little enough to stick to more salt, which as, in this case, the fire doth, so peradventure in the other, the acrimoniousness of the salt doth it.

And this is sufficient to give curious wits occasion, by making further experiments, to search out the truth of this matter. Only, we may note what happens in most of the experiencies we have mention'd; to wit, that things of the same nature joyn better and more easily, then others that are more estranged from one another. Which is very agreeable to reason; seeing that, if nature intends to have things consist long together, she must fit them for such consistence.

II.  
The reason why bodies of the same nature joyn more easily together then others.

Which seems to proceed out of their agreement in four qualities. First, in weight; for bodies of divers degrees in weight, if they be at liberty, seek divers places: and consequently, substances of like weight must of necessity find one another out, and croud together, as we have shew'd, it is the nature of heat to make them do. Now, it is apparent, that things of one nature must, in equal parts, have the same or a near proportion of weight; seeing that, in their composition, they must have the same proportion of Elements.

The second reason, of the consistence of bodies together, that are of the same nature, is the agreement of their liquid parts, in the same degree of rarity and density. For, as it is the nature of quantity in common to make all parts be one quantity; so it is the nature of the degrees of quantity, when two parts meet that are of the same degree, to make them one in that degree of quantity: which is, to make them stick together, in that degree of sticking which the degree of density that is common to them both makes of its own nature. Whereas, parts of different densities cannot have this reason of sticking: though, peradventure they may, upon some other ground, have some more efficacious one. And in this manner, the like humide parts of two bodies, becoming one, the holes or receptacles, in which those humide parts are contain'd, must also needs be united.

The third reason is the agreeable proportion, which their several figures have in respect of one another. For, if any humidi-



ty be extracted out of a mixed body, especially, by the virtue of fire, it must have left pores of such figures, as the humidity that is drawn out of them is apt to be cut into: for every humide body (not being absolutely humide, but having certain dry parts mixed with it) is more apt for one kind of figure and greatness, then for another; and by consequence, whenever that humidity shall meet again with the body it was severed from, it will easily run through and into it all, and fill exactly the cavities pores it passed before.

The last quality in which bodies that are to consist long together agree is, the bigness of the humide & dry parts of the same body. For, if the humide parts be too big for the dry ones, 'tis clear that the dry ones must needs hang loosely together by them, because their glew is in too great a quantity: But, if the humide parts be too little for the dry ones, then of necessity some portion of every little dry part must be unfurnish of glew, by means wherof to stick to his fellow; and so the sticking parts not being conveniently proportion'd to one another, their adhesion cannot be so solid, as if each of them were exactly fitted to his fellow.

#### CHAP. XVIII.

*Of another motion belonging to particular bodies, call'd Attraction; and of certain operations, term'd Magicall.*

I.  
What attraction is, and from whence it proceeds.

**H**AVING thus ended the two motions of rarefaction and condensation; the next that offer themselves are the locall motions, which some bodies have to others. These are sometimes perform'd by a plain force in the body towards which the motion is: and other whiles by a hidden cause, which is not so easily discern'd. The first is chiefly that which is ordinarily said to be done by the force of nature to hinder *vacuum*, and is much practis'd by nature: as, in drawing our breath, in sucking, and many other natural operations, which are imitated by art in making of Pumps, Syphons, and such other instruments: and in that admirable experiment of taking up a heavy Marble stone, merely by another lying flat and smoothly upon it, without any ther connexion of the two stones together, as also by that sport of boyes, when they spread a thin moistned leather upon a smooth broad stone, press it all over close to it, and then by pulling of a string fastned at the middle of the leather, they draw up like-



likewise the heavy stone. In all which, the first cause of the motion proceeds from that body towards which the motion is made: and therefore is properly called Attraction.

For the better understanding and declaring of which, let us suppose two marble stones, very broad and exceeding smoothly polished, to be laid one flat upon the other: and let there be a ring fastned at the back part of the uppermost stone, and exactly in the middle of it. Then, by that ring, pull it up perpendicularly and steadily; and the undermost will follow, sticking fast to the overmost: and though they were not very perfectly polished, yet the nethermost would follow for a while, if the ring be suddenly plucked up; but then it will soon fall down again. Now this plainly shews, that the cause of their sticking so strongly together, when both the stones are very well polished, is for that nothing can well enter between them to part them; and so, 'tis reduced to the shortness of the air betwixt them: which not being capable of so great an expansion, nor admitting to be divided thick-ways, so much as is necessary to fill the first growing distance between the two stones till new air finds a course thither (that so the swelling of the one may hinder vacuity, till the other come into the rescue); the two stones must needs stick together to certain limits, which limits will depend of the proportion that is between the weight, and the continuity of the nethermost stone.

And, when we have examin'd this, we shall understand in what sense it is meant that Nature abhors from Vacuity; and what means she uses to avoid it. For, to put it as an enemy that nature fights against, or to discourse of effects that would follow from it, in case it were admitted, is a great mistake, and a lost labour; seeing it is nothing and, therefore, can do nothing: but is meerly a form of expression, to declare, in short, nothing else but that it is a contradiction, or implication in terms, and an impossibility in nature, for Vacuity to have or be supposed to have a Being.

Thus then, since in our case, after we have cast all about, we can pitch upon nothing to be consider'd but that the two stones touch one another, and that they are weighty, we must apply our selves only to reflect upon the affects proceeding from these two causes, their contiguity and their heaviness: and we shall find



that as the one of them, namely the weight, hinders the undermost from following the uppermost, so, contiguity obliges it to that course; and according as the one overcomes the other, so will this action be continued or interrupted.

Now, that contiguity of substances makes one follow another, is evident, by what our Masters in Metaphysics teach us; when they shew that, without this affect, no motion at all could be made in the world, nor any reason given for those motions we daily see. For, since the nature of quantity is such, that, whenever there is nothing between two parts of it, they must needs touch and adhere and joyn to one another; (for how should they be kept asunder, when there is nothing between them to part them?) if you pull one part away, either some new substance must come to be close to that which removes; (or else the other, which was formerly close to it, must still be close to it, and so follow it: for, if nothing come between, it is still close to it. Thus then, it being necessary that something must be joyn'd close to every thing; Vacuity, (which is nothing) is excluded from having any being in nature.

And, when we say that one body must follow another, to avoid vacuity; the meaning is, that, under the necessity of a contradiction, they must follow one another, and that they cannot do otherwise. For it would be a contradiction, to say that nothing were between two things; and yet that they are not joyn'd close to one another: and therefore, if you should say it, you would in other words say, they are close together, and they are not close together. In like manner, to say that Vacuity is any where, is a pure contradiction; for Vacuity, being nothing has no Being at all: and yet, by those words, it is said to be in such a place; so that they affirm it to be and not to be, at the same time.

3.  
The true reason of attraction.

But now, let us examine if there be no means to avoid this contradiction and vacuity; other then by the adhesion, & following of one body upon the motion of another, that is closely joyn'd to it and every where contiguous. For, sense is not easily quieted with such Metaphysical contemplations, that seem to repugn against her *dictamens*; and therefore, for her satisfaction, we can do no less then give her leave to range about and cast all waies, in hope of finding some one that may better content her: which when she finds that she cannot, she will the less repine to



to yield her assent to the rigorous sequels and proofs of reason.

In this difficulty then, after turning on every side, I for my part can discern no pretence of probability, in any other means but pulling down the lower stone by one corner; that so there may be a gaping between the two stones, to let in air by little and little. And, in this case, you may say that, by the intervention of air, Vacuity is hinder'd; and yet the lower stone is left at liberty to follow its own natural inclination, and be govern'd by its weight. But indeed, if you consider the matter well, you will find that the doing this requires a much greater force, then to have the lower stone follow the upper: for, it cannot gape in a straight line, to let in air, since, in that position, it must open at the bottom where the angle is made, at the same time that it opens at the mouth: and then, air requiring time to pass from the edges to the bottom, it must in the mean while fall into the contradiction of Vacuity. So that, if it should open to let in air, the stone, to compass that effect, must bend; in such sort as wood doth, when a wedg is put into it to cleave it.

Judge then what force it must be, that should make hard marble, of a great thickness, bend like a wand; and whether it would not rather break and slide off, then do so: you will allow that a much less will raise up the lower stone, together with the uppermost. It must then of necessity fall out, that it will follow it, if it be moved perpendicularly upwards. And the like effect will be, though it should be raised at oblique angles; so that the lowermost edge do rest all the way upon something that may hinder the inferiour stone from sliding aside from the uppermost.

And this is the very case of all those other experiments of art and nature, which we have mention'd above: for, the reason holds as well in water and liquide things, as in solid bodies, till the weight of the liquid body overcome's the continuity of it; for then, the third breaks, and it will ascend no higher.

Which height *Galileo* tells us (from the workmen in the *Arsenal* of *Venice*) is 40 foot; if the water be drawn up in a close pipe; in which the advantage of the sides helps the ascent. But others say that the invention is enlarged; and that water may be drawn to what height one pleases. However, the force which nature applies to maintain the continuity of quantity, can have no limit; seeing it is grounded upon contradiction.

4.  
Water may be brought by the force of attraction to what height soever.



And therefore *Galileo* was much mistaken, when he thought to make an instrument, wherby to discover the limits of this force.

We may then conclude, that the breaking of the water must depend from the strength of other causes. As for example, when the gravity is so great, by increasing the bulk of the water, that it will either overcome the strength of the pipe, or else make the sucker of the pump rather yield way to air, then draw up so great a weight: for which defects, if remedies be found, the art may surely be enlarged without end.

5.  
The doctrine  
touching the  
attraction of  
water in Sy-  
phons.

This is particular in a *Syphon*, that, when that arm of it, which hangs out of the water, is lower then the *superficies* of the water; then, it will run of it self, after it is once set on running by sucking. The reason whereof is, because the weight, which is in the water pendant, is greater then the weight of the ascending water; and therby supplies the want of a continual sucker. But, if the nose of that arm that hangs out of the water be put even with the water; then the water will stand still in both pipes or arms of the *Syphon*, after they are filled with sucking. But, if, by the running out of the water, the outward pipe grow shorter then to reach as low as the *superficies* of the water in the fountain from whence it runs; in this case, the water in each arm of the *Syphon* will run back into the fountain.

Withall it is to be noted, that, though the arm which is out of the water be never so long, yet, if it reach not lower then the *superficies* of the fountain, the over quantity and weight of the water there, more then in the other arm, helps it nothing to make it run out. Which is, because the declivity of the other arm over-recompences this overweight. Not that the weight in the shorter pipe has so much force, as the weight in the longer pipe; but because it has more force then the greater weight exercises therein its running: for, the greatest part of its force, tends another way, then to the end of the pipe, to wit, perpendicularly towards the *Centre*; and so is hindred from effect, by the great sloping, or little declivity, of the pipe upon which it leans.

6.  
That the Sy-  
phon doth not  
prove water  
to weigh in its  
own orb.

But, some, considering how the water in that longer arm of the *Syphon* is more in quantity, than the water in the other arm of it, wherat it runs out, admire why the greater quantity of water doth not draw back the less into the cistern; but suffers it self



self to be lifted up, and drain'd away, as if it run steeply downwards. And they imagine, that hence may be deduced, that the parts of water in the cistern do not weigh, as long as they are within the orb of their own body.

To whom we answer, that they should consider how, that to have the greater quantity of water in the longer arme of the Syphon (which arm is immerfed in the water of the cistern) draw back into the cistern the water in the other arm of the Syphon, that hangs out in the air; it must both raise as much of the water of the cistern as its own bulk is, above the level which at present the whole bulk of water has, and withal, at the same time, pull up the water in the other arm. Now 'tis manifest, that these two quantities of water together are heavier then the water in the sunk arm of the Syphon; since one of them single is equal unto it: And by consequence, the more water in the sunk arm cannot weigh back the less water in the hanging arm; since, to do that, it must at the same time weigh up, over and above, as much more in the cistern as it self weighs.

But, turning the argument, I say, that, if once the arm of the Syphon that is in the air be supposed to draw any water, be it never so little, out of the cistern (whether occasioned by sucking or by whatever other means): it follows that as much water as is drawn up, above the level of the whole bulk in the cistern, must needs press into the sunken arm from the next adjacent parts, (that is, from the bottom) to supply its emptying; and as much must of it self press down from above (according to its natural course, when nothing violent it) to rest in the place, that the ascending water, (which is lower then it) leavs at liberty for it to take possession of. And then it cannot be doubted, but that this descending water, having all its weight in pressing down applied to drive up the rising water in the sunk arm of the Syphon, & the water in the other arm of the Syphon without having all its weight in rising out appli'd at the same time to draw up the same water in the sunk arm; this single resistant must yield to their double & mattering force. And consequently, the water in the arm of the Syphon that is in the air must needs draw the water that is the other immerfed arm, as long as the end of its pipe reaches lower then the level of the water in the cistern; for so long



long, it appears by what we have said, it must needs be more weighty, since part of the rising water in the sunk arm of the syphon is counterpois'd by as much descending water in the cistern.

And thus 'tis evident, that, out of this experiment, it cannot be infer'd, that parts of water do not weigh within the orb of their own whole: but only, that two equal parts of water in their own orb (namely that which rises in the sunken arm, and that which presses down from the whole bulke in the cistern) are of equal weight and ballance one another, So that never so little odds, between the two counterpoysing parcels of water which are in the air, must needs make the water run out at that end of the syphon, where the overweight of water is.

7.  
Concerning  
attraction  
caused by fire.

The Attraction, whose cause next to this is most manifest, is that which is made by the force of heat or fire: for, we see that fire ever draws air to it; so notably, that, if in a close room there be a good fire, a man that stands at the door or window (especially without) shall hear such a noise, that he will think there is a great wind within the chamber. The reason of this attraction is, that fire, rarifying the air next it, and withall spending it self perpetually, causes the air, and his own body mingled together to fly up through the chimney, or by some other passage: Whence it follows of necessity, that the next body must succeed into the place of the body that is flown away. The next body generally is air, whose mobility and fluidity, beyond all other bodies, makes it of all others the fittest to be drawn, and the more of it is drawn, the more must needs follow. Now, if there be floating in this air any other atoms, subject to the current which the air takes; they must also come with it to the fire, and by it be rarified and exported out of that little orb.

Hence it is, that men (with very good reason) hold that fire airs a chamber, as we term it; that is, purifies it: both because it purifies it, as wind doth, by drawing a current of air into it that sweeps through it; or by making it purifie it self by motion, as a stream of water doth by running; as also, because those vapours which approach the fire are burned & dissolv'd. So that the air, being noisome and unwholesome, by reason of its grossness, (proceeding from its standing unmoved, like a stagnation of dead water, in a marish place.) the fire takes away that cause of annoyance.

By



By this very rule we learn, that other hot things, which participate the nature of fire, must likewise. (in other respects) have a resemblance in this quality. And accordingly we see, that hot loaves in a Bakers shop, newly drawn out of the Oven, are accounted to draw to them any infection which is in the air. The like we say of onyons, and other strong breathing substances; which by their smell shew much heat in them. In like manner 'tis conceiv'd, that Pigeons and Rabbits and Cats easily take infection; by reason of their extraordinary warmth which they have in themselves.

And this is confirm'd by the practise of Physicians, who use to lay warm Pigeons newly killed to the feet, wrists, or heads of sick persons, and young Puppies to their stomachs, and sometimes certain hot gums to their navels; to draw out such vapours or humours as infest the body: for the same reason, they hang amulets of arsenick, sublimate, dryed Toads, or Spiders, about their patients necks; to draw to them venomous qualities from their bodies. Hence also it is that, if a man be stricken by a Viper or a Scorpion, they use to break the body of the beast it self that stung him (if they can get it) upon the wound: but, if the beast be crawl'd out of their finding, they do the like by some other venomous creature: as I have seen a bruised Toad laid to the biting of a Viper. And they manifestly perceive the apply'd body to swell with the Poyson suck'd out from the wound, & the patient to be reliev'd & have less poyson; in the same manner as, by cupping-glasses, the poyson is likewise drawn out from the wound: so that you may see, the reason of both is the very same; or at least very like one another. Only, we are to note, that the proper body of the beast, out of which the venome was driven into the wound, is more efficacious than any other to suck it out.

And the like is to be observ'd in all other kinds, that such vapours, as are to be drawn, come better and incorporate faster in bodies of like nature, then in those which have only the common conditions of heat and dryness; the one of which serves to attract, the other to fasten and incorporate into it self the moisture which the first draws to it. So we see that water soaks into a dry body, whence it was extracted, almost inseparably, and is hidden in it; as, when it rains first after hot weather, the ground is presently dried after the shower. Likewise we see that, in most ce-  
ments,

8.

Concerning  
attraction  
made by vir-  
tue of hot bo-  
dies; amulets,  
&c.



9.  
The natural  
reason given  
for divers ope-  
rations, effec-  
ted by some  
to be magical.

ments, you must mingle a dust of the nature of the things which are to be cemented, if you will have them bind strongly.

Out of this discourse, we may yield a reason for those Mag. cal operations, which some attribute to the Devils assistance; peradventure because mans wickedness hath bin more ingenious then his good will, and so has found more means to hurt then to help; nay, when he hath arrived some way to help, those very helps have undergone the same calumny, because of the likeness which their operations have to the others. Without doubt very unjustly; if there be truth in the effects: For, where have we any such good suggestions of the enemy of mankind proposed to us, that we may with reason believe he would duly, settledly, and constantly concur to the help and service of all those he so much hates; as he must needs do if he be the Author of such effects? Or, is it not a wrong to Almighty God, and to his careful instruments; rather to impute to the Devil the aids, which to some may seem supernatural, then to them of whom we may justly believe and expect such good Offices and assistances? I mean, those operations, both good and bad, which ordinarily are called Magnetical; though peradventure wrongfully, as not having that property which denominates the loadstone.

One thing I may assure, that, if the reports be true, they have the perfect imitation of nature in them. As for example; that the Weapons-Salve, or the Sympatherick-Powder, requires, in the using it, to be conserved in an equal moderate temper; and that the weapon which made the wound, or the cloth upon which the blood remains that issued from it, be orderly and frequently dressed: or else the wounded person will not be cured. Likewise, the steam or spirits, which at the giving of the wound enter'd into the pores of the weapon, must not be driven out of it, (which will be done by fire: and so, when it is heated by holding over coals, you may see a moisture sweat out of the blade at the opposite side to the fire, as far as it entred into the wounded persons body; which being once all sweated out, you shall see no more the like steam upon the sword), neither must the blood be washed out of the bloody cloth: for, in these cases, the powder, or salve, will work nothing. Likewise, if there be any excess either of heat or cold in keeping the medicated weapon or cloth, the patient feels that, as he would do, if the like  
excess



excess where in any remedy that were applyed to the wound it self. Likewise, if the medicated weapon or bloody cloth, be kept too close, no effect follows. Likewise, the natures of the things used in these cures are, of themselves, soveraign for healing the like griefs; though peradventure too violent, if they were apply'd in body, without much attenuation.

And truly, if we will deny all effects of this kind, we must in a manner renounce all humane faith: men of all sorts and qualities (and many of them such, in my own knowledge, as I cannot question their prudence in observing, or their sincerity in relating) having very frequently made experience of such medicines; and all affirming after one fashion to have found the same effects. Adde to these the multitude of other like effects, appearing, or conceited to appear, in other things. In some Countries 'tis a familiar disease with Kine, to have a swelling in the soles of their feet: and the ordinary cure is, to cut a turf upon which they have troden with their sore foot, and to hang it upon a hedge; & as that dries away, so will their sore amend. In other parts they observe, that if milk, newly come from the cow, in the boyling run over into the fire, and that this happen often and near together to the same cows milk; that cow will have her udder sore inflamed: and the prevention is, to cast salt immediately into the fire upon the milk. The herb *Perficaria*, if it be well rub'd upon Warts, and then be laid in some fit place to putrifie, causes the Warts to wear away, as it rots: some say the like of fresh Beef. Many examples also there are of hurting living creatures, by the like means; which I set not down, for fear of doing more harm, by the evil inclination of some persons into whose hands they may fall, then profit, by their knowing them to whom I intend this work.

But, to make these operations of nature not incredible: let us remember how we have determin'd, that every body whatever yields some steam, or vents a kind of vapour from it self; and consider, how they must needs do so most of all, that are hot and moist, as bloud and milk, and all wounds and sores generally are. We see that the foot of a Hare or Bear leaves such an impression where the beast has passed, as a dog can discern it a long time after: and a Fox breaths out so strong a vapour, that the hunters themselves can wind it a great way off,  
and



and a good while after he is parted from the place. Now, joyn-  
ing this to the experiences we have already allow'd of, concern-  
ing the attraction of heat; we may conclude that, if any of these  
vapours light upon a solid warm body, which has the na-  
ture of a source to them, they will naturally congregate and  
incorporate there: and, if those vapours be joyn'd with any me-  
dicative quality or body, they will apply that medicament bet-  
ter than any Chirurgeon can. Then, if the steam of blood  
and spirits carry with it, from the weapon or cloth, the  
balsamike qualities of the salve or powder; and with them  
settle upon the wound: what can follow but a bettering in it?  
Likewise, if the steam of the corruption that is upon the clod,  
carry the drying quality of the wind, which sweeps over it  
when it hangs high in the air, to the sore part of the cows  
foot; why is it not possible that it should dry the corruption  
there, as well as it dries it upon the hedge; And, if the steam of  
burned milk can hurt, by carrying fire to the dug: why should  
not salt cast upon it be a preservative against it? Or rather, why  
should not salt hinder the fire from being carried thither? Since  
the nature of salt always hinders and suppresses the activity of  
fire: as we see by experience, when we throw salt into the fire  
below, to hinder the flaming of soot in the top of a chimney;  
which presently ceases, when new fire from beneath doth not  
continue it. And thus we might proceed, in sundry other ef-  
fects, to declare the reason and possibility, were we certain of  
the truth of them: therefore we remit this whole question to  
the authority of the testimonies.

## C H A P. XIX.

*Of three other motions belonging to particular bodies, Filtration,  
Restitution, and Electrical attraction.*

I.  
What is Fil-  
tration; and  
how it is effe-  
cted.

**A**fter these, let us cast our eye upon another motion, very fa-  
miliar among Alchymists; which they call *Filtration*. It is  
effected by putting one end of a tongue or label of Flannen, or  
Cotten, or Flax, into a vessel of water; and letting the other  
end hang over the brim of it: And it will, by little and little,  
draw all the water out of that vessel (so that the end which  
hangs out be lower then the *superficies* of the water); and make  
it all come over into any lower vessel you will reserve it in.

The



The end of this operation is, when any water is mingled with gross and muddy parts (not dissolv'd in the water); to separate the pure & light ones from the impure. By which we are taught, that the lighter parts of the water are those which most easily catch. And, if we will examine in particular, how 'tis likely this business passes; we may conceive that the body or *linguet*, by which the water ascends, being a dry one, some lighter parts of the water, whose chance it is to be near the climbing body of Flax, begin to stick fast to it: and then, they require nothing near so great force nor so much pressing, to make them climb up along the flax, as they would do to make them mount in the pure air. As you may see, if you hold a stick in running water, shelving against the stream: the water will run up along the stick, much higher then it could be forced up in the open air without any support; though the agent were much stronger then the current of the stream. And a ball will, on a rebound, run much higher upon a shelving board, then it would if nothing touch'd it. And I have been told that, if an eggshell fill'd with dew be set at the foot of a hollow stick; the Sun will draw it to the top of the shelving stick; whereas without a prop, it will not stir it.

With much more reason then, we may conceive that water, finding as it were little steps in the Cotton, to facilitate its journey upwards, must ascend more easily then those other things do; so as it once receive any impulse to drive it upwards. For, the gravity, both of that water which is upon the Cotton, as also, of so many of the confining parts of water as can reach the Cotton, is exceedingly allay'd; either by sticking to the Cotton, and so weighing in one bulk with that dry body, or else, by not tending down straight to the *Center*, but resting as it were upon a steep plain (according to what we said of the arm of a Syphon that hangs very sloping out of the water, and therefore draws not after it a less proportion of water in the other arm that is more in a direct line to the *Center*): by which means the water, as soon as it begins to climb, comes to stand in a kind of *cone*; neither breaking from the water below, (its bulk being big enough to reach to it) nor yet falling down to it.

But our chief labour must be, to finde a cause that may make the water begin to ascend. To which purpose, consider how water

2.  
What causes  
the water in  
filtration to  
ascend.

of



of its own nature, compresses it self together, to exclude any other body lighter then it is. Now, in respect of the whole mass of the water, those parts which stick to the cotton are to be accounted much lighter then water: not, because in their own nature they are so; but for the circumstances which accompany and give them a greater disposition to receive a motion upwards, then much lighter bodies, while they are destitute of such helps. Wherefore as, the bulk of water weighing and striving downwards, it follows that, if there were any air mingled with it, it would, to possess a lesser place, drive out the aire: so here in this case, the water at the foot of the ladder of cotton, ready to climb with a very small impulse may be, after some sort, compared (in respect of the water) to air, by reason of the lightness of it; and, consequently, is forced up by the compressing of the rest of water round about it. Which no faster gets up, but other parts at the foot of the ladder follow the first, and drive them still upwards along the tow; and new ones drive the second, and others the third, and so forth: so that with ease they climb up to the top of the filter, still driving one another forwards: as you may do a fine towel through a musket barrel, which, though it be too limber to be thrust straight through, yet, craming still new parts into it, at length you will drive the first quite through.

And thus, when these parts of water are got up to the top of the vessel on which the filter hangs, and over it on the other side; by sticking still to the tow, and by their natural gravity, against which nothing presses on this side the label: they fall down again by little and little, and by drops break again into water in the vessel set to receive them.

But now if you ask, why it will not drop, unless the end of the label that hangs be lower then the water? I conceive it is, because the water, which is all along upon the flannel, is one continued body hanging together, as it were a thrid of wire; and is subject to like accidents as such a continued body is. Now, suppose you lay wire upon the edge of the basin, which the filter rests on; and so make that edge the *Centre* to ballance it upon: if the end that is outermost be heaviest, it will weigh down the other; otherwise, not. So fares it with this thrid of water: if the end of it that hangs out of the pot be

3.  
Why the filter will not drop, unless the label hang lower then the water.



be longer, and consequently heavier, then that which rises; it must needs raise the other upwards, and fall it self downwards. Now, the raising of the other implies lifting more water from the Cistern; and the sliding of it self further downwards is the cause of its converting into drops. So that the water in the cistern serves like the flax upon a distaff; and is spun into a thrid of water, still as it comes to the flannen, by the drawing it up, occasion'd by the overweight of the thrid on the other side of the center.

Which to express better by a similitude in a solid body: I remember I have oftentimes seen, in a Mercers shop, a great heap of massy gold lace lie upon their stall; and a little way above it, a round smooth pin of wood, over which they use to have their lace when they wind it into bottoms. Now, over this pin, I have put one end of the lace; & as long as it hung no lower then the board upon which the rest of the lace did lie, it stird'd not: for as the weight of the loose end carried it one way, so the weight of the other side, where the whole was, drew it the other way; & in this manner kept it in equaliberty. But, as soon as I drew on the hanging end to the heavier then the climbing side, (for, no more weights then is in the air, that which lies upon the board having another center); then it began to roule to the ground: and still drew up new parts of that which lay upon the board, till all was tumbled down upon the floor. In the same manner it hap'nes to the water; in which, the thrid of it upon the filter is to be compared fitly to that part of the lace which hung upon the pin, and the whole quantity in the cistern is like the bulk of lace upon the Shopboard: for, as fast as the filter draws it up, 'tis converted into a thrid like that which is already upon the filter; in like manner as the wheel converts the flax into yarn, as fast as it draws it out from the distaff.

Our next consideration will very aptly fall upon the motion of those things which, being bent, leap with violence to their former figure: whereas others return but a little; and others stand in that ply, wherein the bending hath set them. For finding the reason of which effects, our first reflection may be, to note that a *Superficies*, which is more long then broad, contains a less floor, then that whose sides are equal, or nearer being equal: and that, of those surfaces whose lines and angles are

O

all

4.  
Of the motion  
of R situation:  
and why some  
bodies stand  
bent, others  
not.



all equal, that which hath most sides and angles contains still the greater floor. Whence it is that Mathematicians conclude a circle to be the most capacious of all figures: and what they say of lines in respect of a *superficies*, the same, with proportion, they say of surfaces, in respect of the body contained. And accordingly, we see by consequence, that, in the making a bag of a long napkin; if the napkin be sew'd together longwise, it holds a great deal less, then if it be sewd together broadwise.

By this we see plainly, that if any body, in a thick and short figure, be forced into a thinner (which, by becoming thinner, must likewise become either longer or broader; for what it loses one way, it must get another); then that *superficies* must needs be stretched: which, in our case, is a Physical outside, or material part of a solid body; not a Mathematical consideration of an indivisible Entity. We see also that this change of figures happens in the bending of all those bodies, wherof we are now enquiring the reason, why some of them restore themselves to their original figures, and others stand as they are bent.

Then, to begin with the latter sort: we find that they are of a moist nature; as, among metalls, lead and tin, and, among other bodies, those which we account soft. And we may determine that this effect proceeds, partly from the humidity of the body that stands bent; and partly from a driness peculiar to it, that comprehends and fixes the humidity of it. For, by the first, they are render'd capable of being driven into any figure, which nature or art desires: and, by the second, they are preserv'd from having their gravity put them out of what figure they have once receiv'd.

But, because these two conditions are common to all solid bodies; we may conclude that, if no other circumstance concur'd, the effect arising out of them would likewise be common to all such: and therefore, where we find it otherwise, we must seek further for a cause of that transgression. As for example, if you bend the bodies of young trees, or the branches of others; they will return to their due figure. 'Tis true, they will sometimes lean towards that way they have been bent: as may be seen even in great trees after violent tempests, and generally the heads of trees, & the ears of corn, and the grown hedg rows will all bend one way in some countries, where some one wind has a main



main predominance and reigns most continually ; as near the Seashore upon the western coast of *England* ( where the South-West wind blows constantly the greatest part of the year ) may be observed : but this effect, proceeding from a particular and extraordinary cause, concerns not our matter in hand.

We are to examine the reason of the motion of *Restitution*, which we generally see in young trees, and branches of others ; as we said before. In such we see that the earthy part which makes them stiff (or rather stark) abounds more, then in the others that stand as they were bent ; at least in proportion to their natures : but I conceive this is not the cause of the effect we enquire about ; but that 'tis a subtile spirit which hath a great proportion of fire in it. For as, in rarefaction, we found that fire, which was either within or without the body to be rarified, did cause the rarefaction ; either by entring into it, or by working within it : so, seeing here the question is, for a body to go out of a lesser *superficies*, into a greater ( which is the progress of rarefaction, and hapen's in the motion of restitution ) ; the work must needs be done by the force of heat. And because this effect proceeds, evidently, out of the nature of the thing in which it is wrought ; and not from any outward cause : we may conclude, it has its origine from a heat within the thing it self ; or else that was in it, and may be press'd to the outward parts of it, and would link into it again.

As for example, when a young tree is bended , both every mans conceit is, and the nature of the thing makes us believe, that the force, which brings the tree back again to its figure, comes from the inner side that is bent ; which is compress'd together, as being shrunk into a circular figure from a straight one : for, when solid bodies that were plain on both sides are bent, so as on each side to make a portion of a Circle ; the *convex superficies* will be longer then it was before when it was plain, but the *concave* will be shorter. And therefore we may conceive that the spirits, which are in the contracted part, ( being there squeez'd into less room , then their nature well brooks ) work themselves into a greater space ; or else, that the spirits, which are crush'd out of the *convex* side by the extension of it, remain besieging it and strive to get in again, ( in such manner as we have declared when we spoke of attraction, wherein we shew'd



how the emitted spirits of any body will move to their own source, and settle again in it, if they be within a convenient compass; ) and accordingly bring back the extended parts to their former situation: or rather, that both these causes, in their kinds, concur to drive the tree into its natural figure.

5.  
Why some bodies return only in part to their natural figure; others entirely.

But, as we see, when a stick is broken, 'tis very hard to replace all the splinters, every one in its proper situation; so it must of necessity fall out in this bending, that certain insensible parts, both inward and outward, are thereby displaced, and can hardly be perfectly rejoynted. Whence it follows that, as you see the splinters of a half broken stick, meeting with one another, hold the stick somewhat crooked; so these invisible parts do the like, in such bodies as, after bending, stand a little that way: but, because they are very little ones, the tree or branch, that has been never so much bended, may (so nothing be broken in it) be set strait again by pains, without any notable detriment of its strength. And thus you see the reason of some bodies returning in part to their natural figures after the force leaves them that bent them.

Out of which you may proceed to those bodies that restore themselves entirely: whereof steel is the most eminent. And, of it, we know, that there is a fiery spirit in it, which may be extracted out of it; not only by the long operations of calcining, digesting, and distilling it; but even by gross heating, and then extinguishing it in wine and other convenient Liquors, as Physicians use to do. Which is also confirm'd, by the burning of steel-dust in the flame of a candle, before it has been thus wrought upon; which afterwards it will not do: wherby we are taught that, originally, there are store of spirits in steel, till they are sucked out. Being then assured that in steel there is such abundance of spirits, and knowing that it is the nature of spirits to give a quick motion, and seeing that duller spirits in trees make this motion of *Restitution*; we need seek no further, what it is that doth it in steel, or in any other things that have the like nature: which, through the multitude of spirits that abound in them, (especially steel) returns back with so strong a jerk, that their whole body will tremble a great while after, by the force of its own motion.

6.  
Concerning the nature of

By what is said, the nature of those bodies which shrink and stretch may easily be understood: for, they are generally composed



posed of stringy parts, to which if humidity happen to arrive, those bodies they grow thereby thicker and shorter. As we see that drops of which shrink water, getting into a new rope of a well, or into a new cable, will and stretch. swell it much thicker; and by consequence, make it shorter. *Galileus* notes such wetting to be of so great efficacy, that it will shrink a new cable, and shorten it notably; notwithstanding the violence of a tempest, & the weight and jerks of a laden ship, strain it what is possible for them to stretch it. Of this nature leather seems to be, and parchment; and divers other things: which, if they be proportionably moistned (and no exterior force apply'd to extend them), will shrink up; but if they be overwetted, they will become flaccide. Again, if they be suddenly dried, they'll shrivel up; but, if they be fairly dried after moderate wetting, they will extend themselves again to their first length.

The way having been open'd (by what we have discoursed, before we came to the motion of Restitution) towards the discovery of the manner how heavy bodies may be forced upward, contrary to their natural motion, by very small means in outward appearance: let us now examine (upon the same grounds), if like motions to this of water, may not be done in some other bodies, in a subtiler manner. In which more or less needs not trouble us; since we know, that neither quantity nor the operations of it consist in an indivisible, or are limited or determin'd by periods they may not pass. 'Tis enough for us to find a ground for the possibility of the operation: and then the perfecting and reducing of it to such a height, as at first might seem impossible & incredible, we may leave to the Oeconomy of wise nature. He that learns to read, write, or play on the Lute, is, in the beginning, ready to lose heart at every step; when he considers with what labour, difficulty, and slowness he joyns the letters, spells syllables, forms characters, fits and breaks his fingers (as though they were upon the rack), to stop the right frets, and touch the right strings: and yet you see how strange a dexterity is gain'd in all these by industry and practise; and readiness beyond what we could imagine possible, if we saw not dayly the effects.

If then we can but arrive to decipher the first characters of the hidden *Alphabet* we are now taking in hand, and can but spel-



lingly read the first syllables of it, we need not doubt, but that the wise Author of nature, in the masterpiece of the creature (which was to express the excellency of the workman), would with excellent cunning & art dispose all circumstances so aptly, as to speak readily a compleat language rising from those Elements; and that should have as large an extent in practise and expression, beyond those first principles, which we like children only lisp out, as the vast discourses of wisest & most learned men are beyond the spellings of infants: and yet those discourses spring from the same root, as the other spellings do, and are but a raising of them to a greater height; as the admired musick of the best player on a Lute or Harp that ever was is derived from the harsh twangs of course Bowstrings, which are composed together and refined, till at length they arrive to that wonderful perfection. And so, without scruple, we may, in the business we are next falling upon, conclude, that the admirable and almost miraculous effects we see are but the elevating-to-a-wonderful-height those very actions and motions, which we shall produce as causes and principles of them.

8.  
Concerning  
*Electrical*  
attraction, and  
the causes  
of it.

Let us then suppose a solid hard body, of an unctuous nature; whose parts are so subtile and fiery, that, with a little agitation, they are much rarified and breath out in steams, (though they be too subtile for our eyes to discern), like the steam that issues from sweating men or horses, or that which flies from a candle when 'tis put out; but that these steams, as soon as they come into the cold air, are by that cold suddenly condens'd again, and, by being condens'd, shorten themselves, and by little and little retire, till they settle themselves upon the body from whence they sprung; in such manner as you may observe the little tender horns of Snails use to shrink back, if any thing touch them, till they settle in little lumps upon their heads. If, I say, these strings of bituminous vapours should, in their way outwards, meet with any light and spongy body, they would pierce into it, and settle in it: and, if it were of a competent bigness for them to wield, they would carry it with them which way soever they go; so that, if they shrink back again to the fountain from whence they came, they must needs carry back with them the light spongy body they have fixed their darts in.

Consider, then, that, how much heat rarifies, so much cold  
condenses;



condenses; and therefore such parts as by agitation were spun out into a subtile thrūd of an inch long (for example) as they cool, grow bigger and bigger, and consequently shorter and shorter: till at length, they gather themselves back into their main body, and there they settle again in cold *bitumen* as they were at first; and the light body they stick to is drawn back with them, and consequently sticks to the *superficies* of the *bitumen*. As if something were tyed at one end of a lute string extended to its utmost capacity, and the other end were fastned to some pin; as the string shrinks up, so that which is tyed at it must needs move nearer and nearer the pin: which artifice of nature jugglers imitate, when, by means of an unseen, hair, they draw light bodies to them. Now, if all this operation be done, without your seeing the little thrūds which cause it; the matter appears wonderful and strange: But, when you consider this progress that we have set down, you will judge it possible.

And this seems to be the case of those bodies which we call *Electrical*; as yellow Amber, Jet, and the like: all which are of a bituminous unctuous nature; as appears by their easie combustibility and smel, when they are burned. And if some do not so apparently shew this unctuous nature, it is because either they are too hard, or else they have a high degree of aqueous humidity joyn'd with their unctuity: and in them the operation will be duller in that proportion. For, as we see that unctuous substances are more odoriferous than others, and send their streams further off and more efficaciously; so we cannot doubt but such bodies as consist in a moist nature accordingly send forth their emanations in a feebler proportion. Yet, that proportion will not be so feeble, but they may have an *Electrical* effect, as well as the more efficacious *Electrical* bodies: which may be perceptible, if exact experience be made by an instrument like the Marri-ners needle; as our learned Countryman Dr. *Gilbert* teaches.

But, that, in those eminent agents, the spirits, wherby they attract, are unctuous, is plain, because the fire consumes them and so, if the agents be over heated, they cannot work: but moderate heat, even of fire, encreases their operation. Again, they are clog'd by mysty air, or wettine: and likewise, are pierc'd through and cut asunder by spirit of wine, or *aqua ardentes*; but oyl doth not hurt them. Likewise, they yield more spirits in



the Sun then in the shade; and they continue longer, when the air is cleared by North or Eastern winds. They require to be polish'd; either because the rubbing, which polish'd them, takes off from their surfaces the former emanations, which returning back stick upon them, and so hinder the passage of those that are within: or else, because their outsides may be foul; or lastly, because the pores may be dilated by that smoothing. Now, that hardness and solidity is required, argues that these spirits must be quick ones; that they may return smartly, and not be lost through their languishing in the air. Likewise, that all bodies, which are not either exceeding rare, or else set on fire, may be drawn by these unctuous thrids, concludes that the quality by which they do it is a common one, that hath no particular contrarieties: such an one as we see in grease or in pitch, to stick to any thing; from which in like manner nothing is exempted, but fire and air. And lastly, that they work most efficaciously when they are heated by rubbing, rather than by fire, shews that their spirits are excited by motion, and thereby made to fly abroad; in such manner as we see in Pomanders and other perfumes, which must be heated if you will have them communicate their scent. And a like effect as in them, agitation doth in Jet, yellow Amber, and such other Electrical bodies; for, if, upon rubbing them, you put them presently to your nose, you will discern a strong bituminous smell in them. All which circumstances shew, that this electrical virtue consists in a certain degree of rarity or density of the bodies unctuous emanations:

Now, if these refined and viscuous thrids of Jet or Amber, in their streaming abroad, meet with a piece of straw, or hay, or dried leaf, or some such light and spungy body; 'tis no marvel if they glew themselves to it like birdlime: and that in their shrinking back (by being condens'd again and repuls'd, through the coldness of the air) they carry it along with them to their entire body. Which they that only see the effect, and cannot penetrate into a possibility of a natural cause thereof, are much troubled withal.

6.  
*Cabens* his opinion re-  
uted, concern-  
ing the cause  
of Electrical  
motions;

And this seems to me to bear a fairer semblance of truth, then what *Cabens* delivers for the cause of Electrical attractions: whose speculation herein, though I cannot allow for solid, yet I must for ingenious. (And certainly even errors are to be commended,



commended, when they are witty ones; and proceed from a casting-further-about then the beaten Tract of verbal learning, or rather terms, which explicate not the nature of the thing in question). He sayes that the coming of straws and such other light bodies to Amber, Jet, and the like, proceeds from a wind, raised by the forcible breaking out of subtile emanations from the Electrical bodies into the air which brings those light bodies along with it to the Electrical ones.

But this discourse cannot hold. For, First, 'tis not the nature of unctuous emanation (generally speaking) to cause smart motions singly of themselves. Secondly, although they should raise a wind, I do not comprehend how this wind should drive bodies directly back to the source that raised it; but rather any other way; and so, consequently, should drive the light bodies, it meets with in its way, rather from, then towards the Electrical body. Thirdly, if there should be such a wind raised, and it should bring light bodies to the Electrical ones; yet it could not make them stick therto; which we see they do, turn them which way you will; as though they were glew'd together.

Neither do his experiences convince any thing. For, what he saies, that the light bodies are sometimes brought to the Electrical body with such a violence, that they rebound back from it, and then return again to it, makes rather against him: for, if wind were the cause of their motion, they would not return again, after they had leaped back from the Electrical body; no more then we can imagine that the wind it self doth.

The like is of his other experience; when he observ'd that, some little grains of Saw-dust hanging at an Electrical body, the furthestmost of them not only fell off, but seem'd to be driven away forcibly: for, they did not fall directly down, but sideways; and besides, flew away with a violence and smartness, that argued some strong impulse. The reason wherof might be, that, new emanations might smite them; which, not sticking and fast'ning upon them, wherby to draw them nearer, must needs push them further: or it might be that the emanations, to which they were glew'd, shrinking back to their main body, the latter grains were shoulder'd off by others that already besieg'd the *Superficies*; and then, the emanations retiring swiftly, the grains must break off with a force: or else we may conceive it was the  
force



force of the air that bore them up a little, which made an appearance of their being driven away; as we see feathers and other light things descend not straight down.

## CHAP. XX.

*Of the Loadstones generation; and its particular motions.*

I.  
The extreme heat of the Sun under the *Zodiack*, draws a stream of air from each pole into the *Torrid Zone*.

**T**HERE is yet remaining the great Mystery of the *Loadstone* to discourse of: Which all Authors, both ancient and modern, have agreed upon as an undeniable example and evidence of the shortness of mans reach in comprehending, and of the impossibility of his reason in penetrating into and explicating such secrets, as nature hath a mind to hide from us. Wherefore our Reader (I am sure) will not, in this subject, expect clear satisfaction or plain demonstrations, at our hands: but will judge we have fairly acquitted our selves, if what we say be any whit plausible.

Therefore, to use our best indeavours to content him; let us reflect upon the disposition of parts of this habitable Globe, wherof we are Tenants for life: And we shall find that the Sun, by his constant course under the *Zodiack*, heats a great part of it unmeasurably more then he doth the rest. And consequently, that this *Zodiack*, being in the mid'st between two (as it were) ends, which we call the *Poles*; these *Poles* must necessarily be extremely cold, in respect of the *Torrid Zone*: for, so we call that part of the earth which lies under the *Zodiack*.

Now, looking into the consequence of this, we find that the Sun, or the Suns heat which reflects from the earth in the *Torrid Zone*, must rarifie the air extremely; and, according to the nature of all heat and fire, must needs carry away from thence many parts of the air and earth sticking to that heat, in such sort as we have formerly declar'd.

Whence it follows, that other air must necessarily come from the Regions towards both the *Poles*, to supply what is carried away from the middle; as is the course in other fires, and as we have explicated above \*. Especially considering that the air, which comes from the Polewards, is heavier then the air of the *Torrid Zone*, and therefore, must naturally press to be still nearer the earth; and so, as it were shoulders on the air of

\* Chap. 18. Sect. 7.



of the *Torrid Zone* towards the circumference, by rolling into its place : and this, in great quantities ; and consequently, the polar air must draw a great train after it.

Which, if we consider the great extent of the *Torrid Zone*, we shall easily persuade our selves, must reach on each side, to the very Pole. For, taking from *Archimedes*, that the *Spherical Superficies* of a portion of a Sphere is, to the *Superficies* of the whole Sphere, according as the parts of the *axis* of that Sphere, comprised within the said portion, is to the whole *axis* : and considering that (in our case) the part of the *axis* comprised within the *Torrid Zone* is, to the whole *axis* of the earth, in about the proportion of 4. to 10 : it must of necessity follow, that a fire or great heat, reigning in so vast an extent, will draw air very powerfully from the rest of the world.

Neither let any man apprehend, that this course, of the Sun's elevating so great quantities of Atoms in the *Torrid Zone*, should hinder the course of gravity there. (For, first, the *medium* is much rarer in the *Torrid Zone*, then in other parts of the earth; and therefore the force of the descending Atoms needs not be so great there as in other places, to make bodies descend there as fast as they do elsewhere. Secondly, there being a perpetual supply of fresh air from the Polar parts, streaming continually into the *Torrid Zone*; it must of necessity happen that, in the air, there come Atoms to the *Torrid Zone*, of that grossness that they cannot suddenly be so much rarified as the subtiler parts of air that are there : and therefore, the more those subtiler parts are rarified, and thereby happen to be carried up; the stronger and the thicker the heavier Atoms must descend. And thus this concurrence of air from the Polar parts maintains gravity under the *Zodiack* ; where otherwise all would be turned into fire, and so have no gravity.

Now, who considers the two *Hemispheres*, which, by the *Equator* are divided, will find that they are not altogether of equal complexions ; but that our Hemisphere, in which the Northpole is comprised, is much dryer then the other, by reason of the greater continent of land in this, and the vast tract of Sea in the other; and therefore, the supply which comes from the divers Hemispheres must needs be of different natures ; that which comes from towards the Southpole, being compared to

2.  
The Atoms of these two streams coming together are apt to incorporate with one another.



that which comes from towards the North, as the more wet to the more dry. Yet, of how different complexions soever they be, you see they are the emanations of one and the same body. Not unlike to what nature hath instituted in the rank of *Animals*: among whom the Male and Female are so distinguish'd by heat and cold, moisture and drought, that nevertheless all belongs but to one nature; and that, in degrees, though manifestly different, yet so near together, that the body of one is, in a manner, the same thing, as the body of the other. Even so, the complexions of the two Hemispheres are in such sort different in the same qualities, that nevertheless they are of the same nature; and are unequal parts of the same body which we call the Earth. Now, Alchemists assure us, that, if two extractions of one body meet together, they will incorporate one with the other; especially, if there be some little difference in the complexion of the extractions.

3.  
By the meeting and mingling together of these streams at the Equator, divers rivolets of Atoms of each Pole are continued from one Pole to the other.

Whence it follows, that these two streams of air, making up one continueate flood of various currents, from one end of the world to the other; each stream that come to the *Equator* from its own Pole by the extraction of the Sun, and that is still supply'd with new matter flowing from its own Pole to the *Equator*, before the Sun can sufficiently rarifie and lift up the Atomes that came first Perpendicularly under its beams, (as it uses to happen in the effects of Physical causes, which cannot be rigorously ajusted, but must have some latitude; in which nature inclines ever rather to abundance then to defect), will pass even to the other pole, by the conduct of his fellow, in case he be by some occasion driven back homewards.

For, as we see in a Bowl or Pail full of water, or rather in a Pipe, through which the water runs along; if there be a little hole at the bottome or side of it, the water will wriggle and change its course to creep out at that Pipe: especially if there be a little spiggot, or quill at the outside of the hole, that by the narrow length of it helps in some sort (as it were) to suck it. So, if any of the files of the army or flood of Atoms, sucked from one of the Poles to the *Equator*, do there find any gaps, or chinks, or lanes of retiring files in the front of the other poles *battalia* of atomes, they will press in there, (in such mannner as we have above declared that water doth by the help of a label of



of cotten, and as is exemplified in all the attractions of venime by venomous bodies, wherof we have given many examples above): and they will go along with them the course they go. For as, when a thick short gilded ingot of silver is drawn out into a long subtil wyre; the wyre, continuing still perfectly gilded all over, manifestly shews that the outside and the inside of the ingot strangely meet together, and intermix in the drawing out: so this little stream, which (like an Eddy current) runs back from the *Equator* towards its own Pole, will continue to the end still tinged with the mixture of the other Poles atoms, it was incorporated with at his coming to the *Equator*.

Now, that some little rivolets of air and atoms should run back to their own Pole, contrary to the course of their main stream, will be easy enough to conceive; if we but consider that, at certain times of the year, winds blow more violently and strongly from some determinate part or Rombe of the world, then they do at other times, and from other parts. As for example; our *East India* Marriners tell us of the famous *Monsoones* they find in those parts: which are strong winds that reign constantly six moneths of the year from one polewards, and the other six moneths from the other pole; & beginning precisely about the Suns entring into such a sign or degree of the *Zodiac*, and continue til about its entrance into the opposite degree. And, in our parts of the world, certain smart Easterly or Northeasterly winds reign about the end of *March* and beginning of *April*; when it seems that some snows are melted by the spring heats of the Sun. And other winds have their courses in other seasons, upon other causes. All which evidently convince, that the course of the air and vapours, from the poles to the *Equator*, cannot be so regular and uniform, but that many impediments and crosses light in the way, to make breaches in it; and therby to force it in some places to an opposite course. In such sort as we see happens in eddy waters, and in the course of a tide; wherein the stream, running swiftly in the middle, beats the edges of the water to the shore, and therby makes it run back at the shore. And hence we may conclude that, although the main course of air & atoms (for example, from North to South, in our Hemisphere) can never fail of going on towards the *Equator*, constantly at the same



same rate, in gross; nevertheless, in several particular little parts of it, (and especially at the edges of those streams that are driven on faster then the rest, by an extraordinary and accidental violent cause) it is variously interrupted, and sometimes intirely stop'd, and other times even driven back to the Northwards.

And, if peradventure any man should think that this will not fall out; because each stream seems to be always coming from his one Pole to the *Equator*, and therefore will oppose and drive back any bodies that with less force should strive to swim against it; or, if they stick to them, will carry them back to the *Equator*. We answer, that we must not conceive the whole air in body doth every where equally incroach from the Polewards upon the Torrid Zone; but, as it were, in certain brooks or rivulets, according as the contingency of all causes put together makes it fall out.

Now then, out of what we have said, it will follow, that, since all the air in this our Hemisphere is, as it were, strew'd over and sow'd with abundance of Northern atoms; and that some brooks of them are in station, others in a motion of retrogradation back to their own North Poles: the Southern atoms (which, coming upon them at the *Equator*, do not only press in among them, wherever they can find admittance, but also go on forwards to the North Poles in several files by themselves; being driven that way by the same accidental causes, which make the others retire back), seizing in their way upon the northern ones, in such manner as we described in filtration, and thereby creeping along by them wherever they find them standing still, and going along with them wherever they find them going back, must of necessity find passage in great quantites towards and even to the North Pole; though some parts of them will ever and anon be check'd in this their journey by the main current prevailing over some accidental one, and so be carried back again to the *Equator*, whose line they had crossed.

And this affect cannot choose but be more or less, according to the seasons of the year. For, when the Sun is in the *Tropick* of *Capricorn*, the southern atoms will flow in much more abundance, and with far greater speed, into the Torrid Zone, then the northern atoms can; by reason of the Suns approximation to the South, and his distance from the North Pole: since he

works



works faintest, where he is furthest off; and therefore from the North no more emanations or Atoms will be drawn, but such as are most subtilised and duly prepared for that course. And, since only these selected bands do now march towards the *Equator*; their files must needs be thinner, then when the Sun being in the *Equator* or *Tropick* of *Cancer* wakens and musters up all their forces. And consequently, the quiet parts of air between their files (in which like Atoms are also scatter'd) are the greater; wherby the advenient Southern Atoms have the larger filter to climb up by. And the like happens in the other Hemisphere, when the Sun is in the *Tropick* of *Cancer*; as who will bestow the pains to compare them, will presently see.

Now then, let us consider what these two streams thus incorporated, must of necessity do in the surface or upper parts of the Earth. First, 'tis evident they must needs penetrate a pretty depth into the Earth: for so freezing perswades us; and much more, the subtile penetration of divers more spiritual bodies, of which we have sufficiently discoursed above. Now, let us conceive that these steams find a body, of a convenient density to incorporate themselves in, in the way of density; as we see fire doth in iron, and in other dense bodies: and this not for an hour or two, as happens in fire; but for years: as I have been told that, in the extreme cold hills in the *Peak* in *Darbyshire*, happens to the dry Atoms of cold; which are permanently incorporated in water by long continual freezing, and so make a kind of Chrystal.

In this case, certainly it must come to pass, that this body will become in a manner, wholly of the nature of these steams; which being drawn from the Poles that abound in cold and driness, (for others, that have not these qualities, do not contribute to the intended effect), the body is aptest to become a stone: for, so we see that cold and drought turns the superficial parts of the earth into stones & rocks; & accordingly, wherever cold & dry winds reign powerfully, all such Countries are mainly rocky.

Now then, let us suppose this stone to be taken out of the earth and hang'd in the air, or set conveniently on some little pin; or otherwise put in liberty, so as a small impulse may easily turn it any way: it will in this case certainly follow, that the

end

4.  
Of these Atoms, incorporated with some fit matter in the bowels of the earth, is made a stone.

5.  
This stone works by emanations joyned with agreeing steams that meet them in the air; and in fine it is a Load-stone.



end of the stone, which in the earth lay towards the North pole, will now in the air convert it self, in the same manner, towards the same point; and the other end, which lay towards the South, turn by consequence to the South. I speak of these Countries which lie between the *Equator* and the North; in which of necessity the stream going from the North to the *Equator* must be stronger then the opposite one.

Now, to explicate how this is done. Suppose the stone hang'd East and West freely in the air; the steam, which is drawn from the North Pole of the earth, ranges along by it in its course to the *Equator*; and, finding in the stone the South steam (which is grown innate to it) very strong, it must needs incorporate it self with it, and most by those parts of the steam in the stone which are strongest; which are they that come directly from the North of the stone, (by which I mean that part of the stone that lay Northward in the Earth, and that still looks to the North pole of the Earth now it is in the air). And therefore, the great flood of atoms coming from the North pole of the earth will incorporate it self most strongly, by the North end of the stone, with the little flood of Southern atoms it findes in the stone: for that end serves for the coming out of the Southern atoms, and sends them abroad; as the South end doth the Northern steam, (since the steams come in at one end, and go out at the other.)

From hence we may gather, that this stone will joyn and cleave to its attractive; whenever it happens to be within the Sphere of its activity. Besides, if, by some accident it should happen, that the atoms or steams, which are drawn by the Sun from the Polewards to the *Equator*, should come stronger from some part of the earth, which is on the side hand of the Pole, then from the very Pole it self; in this case the stone will turn from the Pole towards that side. Lastly, whatever this stone will do towards the Pole of the earth; the very same a lesser stone of the same kind will do towards a greater. And, if there be any kind of other substance that has participation of the nature of this stone, such a substance will behave it self towards this stone, in the same manner as such a stone behaves it self towards the earth: all the *Phenomens* whereof may be the more plainly observed, if the stone be cut into the form of the earth.

And



And thus, we have found a perfect delineation of the Loadstone, from its causes. For, there is no man so ignorant of the nature of a Loadstone, but he knows that the properties of it are to tend towards the North; to vary sometimes; to joyn with another Loadstone; to draw iron to it: and such like, whose causes you see deliver'd.

But, to come to experimental proofs and observations on the Loadstone, by which it will appear that these causes are well esteem'd and apply'd; we must be beholding to that admirable searcher of the nature of the Loadstones *Dr. Gilbert*: by means of whom and *Dr. Harvey*, our Nation may claim, even in this latter age, as deserved a crown for solid Philosophical learning; as, for many ages together, it hath done formerly for acute and subtile speculations in Divinity. But, before I fall to particulars, I think it worth warning my Reader, how this Great Man arriv'd to discover so much of Magnetical Philosophy; that he likewise, if he be desirous to search into nature, may, by imitation, advance his thoughts and knowledge that way.

6  
A methode  
for making  
experiences  
on any sub-  
ject.

In short, then; all the knowledg he got of this subject was by forming a little Loadstone into the shape of the earth. By which means he compassed a wonderful design, which was, to make the whole globe of the earth maniable: for, he found the properties of the whole earth in that little body; which he therefore called a *Terrella*, or little earth, and which he could manage and try experiences on, at his will. And in like manner, any man, that has an aim to advance much in natural Sciences, must endeavour to draw the matter he enquires of into some smal model, or into some kind of manageable method; which he may turn and wind as he pleases: and then let him be sure, if he hath a competent understanding, that he will not miss of his mark.

But, to our intent; the first thing we are to prove is, that the Loadstone is generated in such sort as we have described. For proof wherof, the first ground we will lay shall be to consider how, in divers other effects, it is manifest, that the differences of being expos'd to the North or to the South, cause very great variety in the same thing: as hereafter, we shall have occasion to touch, in the barks and grains of trees, and the like. Next, we find by experience, that this virtue of the Loadstone is receiv'd

7.  
The Load-  
stones genera-  
tion, by atoms  
flowing from  
both Poles, is  
confirm'd by  
experiments  
observ'd in the  
stone it self.

P

into



into other bodies that resemble its nature, by heatings and coolings: for, so it passes in iron bars, which, being thoroughly heated, and then laid to cool North and South, are thereby imbued with a Magnetick virtue; heat opening their bodies, and disposing them to suck in such atoms as are convenient to their nature, that flow to them whiles they are cooling. So that we cannot doubt, but convenient matter, fermenting in its warm bed under the earth, becomes a Loadstone; by the like sucking in of affluent streams, of a like complexion to the former.

And it fares in like manner with those fiery instruments (as fire-forks, tongues, shovels, and the like) which stand constantly upwards and downwards; for they, by being often heated and cool'd again, gain a very strong verticity, or turning to the Pole: and indeed, they cannot stand upwards and downwards so little a while, but they will in that short space gain a manifest verticity; and change it at every turning. Now, since the force and vigour of this verticity is in the end that stands downwards, 'tis evident that this effect proceeds out of an influence receiv'd from the earth.

And because in a Load-stone (made into a globe, or consider'd so, to the end you may reckon Hemispheres in it, as in the great earth) either Hemisphere gives to a needle touch'd upon it, not only the virtue of that Hemisphere where it is touch'd, but likewise the virtue of the contrary Hemisphere: we may boldly conclude, that the virtue which a Loadstone is impregnated with, in the womb or bed of the earth where it is form'd and grows, proceeds as well from the contrary Hemisphere of the earth, as from that wherein it lyes; in such sort, as we have above described. And, as we feel oftentimes in our own bodies, that some cold we catch remains in us a long while after the taking it, and sometimes seems even to change the nature of some part of our body, into which it is chiefly enter'd and hath taken particular possession of: so that, whenever new atoms of the like nature again range about in the circumstant air, that part, so deeply affected with the former ones of-kin to these, in a particular manner seems to dissent and attract them to it; and to have its guests within it (as it were) waken'd and rous'd up, by the strokes of the advenient ones that knock at their doors. Even so (but much more strongly, by reason of the longer time and less



less hinderances) we may conceive, that the two virtues or atoms, proceeding from the two different Hemispheres, constitute a certain permanent and constant nature in the stone that imbibes them: which, then, we call a Loadstone; and is exceeding sensible (as we shall hereafter declare) of the advenience to it of new atoms, a like in nature and complexion to those it is impregnated with.

And this virtue, consisting in a kind of softer and tenderer substance than the rest of the stone, becomes thereby subject to be consumed by fire. From whence we may gather the reason, why a Loadstone never recovers its magnetick virtue, after it hath once lost it; though iron doth: for the humidity of iron is inseparable from its substance; but the humidity of a Loadstone, which makes it capable of this effect, may be quite consumed by fire, and so the stone may be left too dry, for ever being capable of imbibing any new influence from the earth, unless it be by a kind of new making it.

In the next place, we are to prove, that the Loadstone works in that manner we have shew'd. For which end, let us consider how the atoms, that are drawn from each Pole and Hemisphere of the earth to the Equator, making up their course by a manuduction of one another, the hindermost cannot choose but still follow on after the formost. And, as it happens in filtration by a cotton cloath, if some one part of the cotton have its disposition to the ascent of the water more perfect and ready, then the other parts have; the water will assuredly ascend faster in that part, then in any of the rest: so, if the atoms find a greater disposition for their passage, in any one part of the *Medium* they range through, then in another; they will certainly not fail of taking that way, in greater abundance and with more vigour and strength, then any other.

But 'tis evident that, when they meet with such a stone as we have described, the helps, by which they advance in their journey, are notably encreas'd by the flood of atoms they meet coming out of that stone; which being of the nature of their opposite pole, they seize greedily upon them, and thereby pluck themselves faster on: like a Ferry man, that draws on his boat the swiftest, the more vigourously he tugs and pulls at the rope that lyes thwart the river for him to hale himself over by. And

8.

Experiments  
to prove that  
the Loadstone  
works by ema-  
nation's meet-  
ing with  
agreeing  
streames.



therefore, we cannot doubt but this flood of atoms, streaming from the pole of the earth, must needs pass through that stone, with more speed and vigour then they can do any other way.

And, as we see in the running of water, if it meets with any lower crannies then the wide channel it streams in; it will turn out of its straight way, to glide along there where it findes an easier and more declive bed to tumble in: so these atoms will infallibly deturn themselves from their direct course, to pass through such a stone, as far as their greater conveniency leads them.

And, what we have said of these atoms, which from the Poles range through the vast sea of air to the *Equator*, is likewise to be appli'd to those atoms which issue out of the stone: so that we may conclude, that, if they meet with any help which may convey them on with more speed and vigour, then whiles they stream directly forwards; they will likewise deturn themselves from directly forwards, to take that course. And, if the stone itself be hang'd so nicely, that a less force is able to turn it about, then is requisite to turn awry, out of its course, the continued stream of atoms which issues from the stone: in this case, the stone itself must needs turn towards that stream, which climbing and filtering it self along the stones stream, draws it out of its course; in such sort as the nose of a Weather-cock butts it self into the wind. Now, then, it being known, that the strongest stream comes directly from the North, in the great earth; and that the Southern stream of the *Terrella*, or Loadstone, (proportion'd duly by nature to incorporate with the North stream of the earth) issues out of the north end of the stone; it follows plainly that, when a Loadstone is situated at liberty, its North end must necessarily turn towards the North pole of the World.

And it will likewise follow, that, whenever such a stone meets with another of the same nature and kind, they must comport themselves to one another in like sort: that is, if both of them be free and equal, they must turn themselves to or from one another according as they are situated in respect of one another. So that, if their *axis* be parallel, and the South pole of the one and the North of the other look the same way, they will send proportionate and greening streams to one another from



from their whole bodies, that will readily mingle and incorporate with one another, without turning out of their way, or seeking any shorter course, or changing their respects to one another.

But, if the poles of the same denomination look the same way, and the loadstones do not lie so as to have their *axis* parallel, but that they incline to one another: then they will work themselves about, till they grow, by their opposite poles, into a straight line; for the same reason, as we have shew'd of a loadstone turning to the pole of the earth.

But, if only one of the loadstones be free, and the other fixed, and that they lie inclined, as in the former case; then, the free stone will work himself, till his pole be opposite to that part of the fixed stone, from whence the stream which agrees with him issues strongest; for that stream is to the free loadstone, as the Northern stream of the earth is to a loadstone compared to the earth. But withal, we must take notice that, in this our discourse, we abstract from other accidents; and particularly, from the influence of the earth's streams into the loadstones: which will cause great variety in these cases, if they lie not due North & South, when they begin to work. And, as loadstones and other magnetick bodies thus of necessity turn to one another, when they are both free; and, if one of them be fast'ned, the other turns to it: so likewise, if they be free to progressive motion, they must, by a like necessity and for the same reason, come together and joyn themselves to one another. And, if only one of them be free, that must remove it self to the other; for, the same vertue that makes them turn (which is the strength of the steam) will likewise (in due circumstances) make them come together; by reason that the steams, which climb up one another by the way of filtration, and thereby turn the bodies of the stones upon their *centers*, when they are only free to turn, must likewise draw the whole bodies of the stones entirely out of their places, and make them joyn; when such a total motion of the body is an effect that requires no more force, than the force of conveying vigorously the streams of both the Magnetick bodies into one another, that is, when there is no such impediment standing in the way of the Magnetick bodies motion, but that the celerity of the atomes motion, mingling with one another, is able to overcome it. For, then, it must needs do so; and the magnetick body, by natural coherence to the steam



of atomes in which it is involved, follows the course of the steam: in such sort as in the example we have heretofore, upon another occasion, given of an eggs-shell fill'd with dew; the Sunbeams converting the dew into smoke, and raising up that smoke or steam, the eggs-shell is likewise rais'd up for company with the steam that issues from it.

And, for the same reason it is, that the Load-stone draws iron; For, iron being of a nature apt to receive and harbor the steams of a Loadstone, it becomes a weak loadstone, and works towards a loadstone, as a weaker Loadstone would do: & so moves towards a Loadstone, by the means we have now described. And, that this conformity between iron and the Loadstone is the true reason of the Loadstones drawing iron is clear, out of this, that a Loadstone will take up a greater weight of pure iron, then it will of impure or drossie Iron, or of Iron and some other mettall joyn'd together; and that it will draw further through a slender long Iron, then in the free open air: all which are manifest signs, that iron co-operates with the force which the Loadstone grafts in it. And the reason why iron comes to a loadstone more efficaciously then another loadstone doth, is, because loadstones generally are more impure then iron is (as being a kind of Oar or Mine of Iron) and have other extraneous and Heterogeneal natures mix'd with them: whereas iron receives the loadstones operation in its whole substance.

### C H A P. XXI.

*Positions drawn out of the former Doctrine, and confirm'd by experimental proofs.*

I.  
The operations of the loadstone are wrought by bodies and not by qualities.

**T**He first Position is, that, The working of the loadstone, (being throughout according to the tenour of the operation of bodies) may be done by bodies; and consequently, is not done by occult or secret qualities. Which is evident out of this; that a greater loadstone has more effect then a lesser: and that, if you cut away part of a loadstone, part of his vertue is likewise taken from him; and if the parts be join'd again, the whole becomes as strong as it was before.

Again, if a loadstone touch a longer iron, it gives it less force then if it touch a shorter: nay, the vertue in any part is sensibly



sensibly lesser, according as it is further from the touched part.

Again, the longer an iron is in touching, the greater vertue it gets, and the more constant. And, both an iron and a loadstone may lose their vertue, by long lying out of their due order and situation, either to the earth or to another loadstone.

Besides, if a loadstone touch a long iron in the middle of it, he diffuses his vertue equally towards both ends; and, if it be a round plate, he diffuses his vertue equally to all sides.

And lastly, the vertue of a loadstone, as also of an iron touched, is lost by burning it in the fire. All which symptoms, agreeing exactly with the rules of bodies, make it undeniable, that the vertue of the loadstone is a real and solid body.

Against this position *Cabeus* objects, that little atomes would not be able to penetrate all sorts of bodies; as we see the vertue of the loadstone doth: And argues, that, although they should be allow'd to do so, yet they could not be imagin'd to penetrate thick and solid bodies so suddenly, as they would do thin ones; and would certainly shew then some sign of facility or difficulty of passing, in the interposition and taking away of bodies put between the loadstone and the body it works upon. Secondly, he objects that atomes, being little bodies; cannot move in an instant; as the working of the loadstone seems to do. And lastly, that the loadstone, by such abundance of continual evaporations, would quickly be consumed.

To the first we answer, That atomes, whose nature 'tis to pierce iron, cannot reasonably be suspected of inability to penetrate any other body: and, that atomes can penetrate iron, is evident, in the melting of it by fire. And indeed this objection comes now too late; after we have so largely declared the divisibility of quantity, and the subtilty of nature in reducing all things into extreme small parts: for, this difficulty has no other avow, then the tardity of our imaginations, in subtilizing sufficiently the quantitative parts that issue out of the loadstone.

As for any tardity that may be expected by the interposition of a thick or dense body, there is no appearance of such; since we see light pass through thick glasses, without giving any sign of meeting with the least opposition in its passage, (as we have above declared at large): and magnetical emanations have the advantage of light in this, that they are not obliged to straight lines, as light is.

2.  
Objections against the former position answer'd.



Lastly, as for Loadstones spending themselves by still venting their emanations; odoriferous bodies furnish us with a full answer to that objection: for, they continue many years palpably spending themselves, and yet keep their odour in vigour; whereas a loadstone, if it be laid in a wrong position, will not continue half so long. The reason of the duration of both which makes the matter manifest, and takes away all difficulty: which is, that, as in the root of a vegetable there is a power to change the adventitious juyce into its nature; so is there, in such like things as these, a power to change the ambient air into their own substance: as evident experience shews in the Hermetike Salt, (as some modern writers call it), which is found to be repair'd, and encreas'd in its weight, by lying in the air; and the like happens to Saltpeter. And, in our present subject, experience informs us, that a Loadstone will grow stronger by lying in due position either to the earth, or to a stronger Loadstone, whereby it may be better impregnated; and, as it were, feed it self with the emanations issuing out of them into it.

3.  
The Load-  
stone is imbu-  
ed with his  
virtue from  
another body.

Our next position is, that, This virtue comes to a magnetick body, from another body; as the nature of bodies is, to require a being moved, that they may move. And this is evident in iron, which, by the touch, or by standing in due position near the loadstone, gains the power of the Loadstone. Again, if a Smith, in beating his iron into a rod, observe to lay it North & South; it gets a direction to the North, by the very beating of it. Likewise, if an iron rod be made red hot in the fire, and kept there a good while together, and, when it is taken out, be laid to cool just North and South; it will acquire the same direction towards the North. And this is true not only of iron, but also of all other sorts of bodies whatever that endure such ignition: particularly of pot-earths, which, if they be moulded in a long form, and, when they are taken out of the Kiln, be laid (as we said of the iron) to cool North and South, will have the same effect wrought in them. And iron, though it has not been heated, but only continued long unmoved in the same situation of North and South in a building; yet it will have the same effect. So as it cannot be denied, but this virtue comes to iron from other bodies: wherof one must be a secret influence from the North. And this is confirm'd, by a Loadstone losing its virtue (as  
we



we said before ) by lying a long time unduly disposed, either towards the earth, or towards a stronger Loadstone; wherby, instead of the former, it gains a new virtue according to that situation.

And this happens, not only in the virtue which is resident and permanent in a Loadstone, or a touch'd iron, but likewise in the actual motion or operation of them. As may be experienc'd, First, in this, that the same loadstone or touch'd iron, in the South hemisphere of the world, hath its operation strongest at that end of it which tends to the North; and in the North Hemisphere, at the end which tends to the South: each pole communicating a vigour proportionable to its own strength, in the climate where it is receiv'd. Secondly, in this, that an iron joyn'd to a Loadstone, or within the Sphere of the Loadstones working, will take up another piece of iron greater then the Loadstone of it self can hold; and, as soon as the holding iron is removed out of the sphere of the Loadstones activity, it presently lets fall the iron it formerly held up. And this is so true, that a lesser loadstone may be placed so within the sphere of a greater loadstones operation, as to take away a piece of iron from the greater Loadstone: and this in virtue of the same greater Loadstone from which it plucks it; for, but remove the lesser out of the sphere of the greater, and then it can no longer do it. So that 'tis evident, in these cases, the very actual operation of the lesser Loadstone, or of the iron; proceeds from the actual influence of the greater Loadstone upon and into them. And hence we may understand, that, whenever a magnetick body works, it has an excitation from without; which makes it issue out and send its streams abroad: so as 'tis the nature of all bodies to do; and as we have given examples of the like done by heat, when we discours'd of Rarefaction.

But, to explicate this point more clearly, by entring more particularly into it. If a magnetick body lyes North and South, 'tis easie & obvious to conceive, that the streams, coming from North and South of the world, & passing through the stone, must needs excitate the virtue which is in it, and carry a stream of it along with them that way they go: But, if it lyes East & West, then the streams of North and South of the earth, streaming along by the two poles of the stone, are suck'd in by them much more weakly; yet



yet nevertheless, sufficiently to give an excitation to the innate streams which are in the body of the stone, to make them move on in their ordinary course.

4.  
The virtue of  
the Loadstone  
is a double,  
and not one  
simple virtue.

The third position is, that, The virtue of the Loadstone is a double, and not one simple virtue. Which is manifest in an iron touch'd by a Loadstone: for, if you touch it only with one pole of the stone, it will not be so strong and full of the magnetike virtue; as if you touch one end of it with one pole, and the other end of it with the other pole of the stone. Again, if you touch both ends of an iron with the same pole of the stone, the iron gains its virtue at that end which was last touch'd; & changes its virtue from end to end, as often as it is rub'd at contrary ends. Again, one end of the Loadstone, or of iron, touch'd will have more force on the one side of the *Equator*, and the other end on the other side of it. Again, the variation on the one side of the *Equator*, and the variation on the other side of it, have different laws; according to the different ends of the loadstone, or of the needle, which looks to those Poles.

Wherefore tis evident, that there is a double virtue in the loadstone; the one more powerful at one end of it, the other at the other. Yet these two virtues are found in every sensible part of the stone: for, cutting it at either end, the virtue at the contrary end is also diminish'd; and the whole loadstone that is left has both the same virtues, in proportion to its bigness. Besides, cut the Loadstone how you will, still the two poles remain in that line, which lay under the *Meridian* when it was in the earth. And the like is of the touched iron: whose virtue still lies along the line which goes straight (according to the line of the *Axis*) from the point where it was touch'd; and, at the opposite end, constitutes the contrary pole.

5.  
The virtue of  
the Loadstone  
works more  
strongly in  
the poles of  
it, then in a-  
ny other part.

The fourth position is, that, Though the virtue of the Loadstone be in the whole body; Yet its virtue is more seen in the poles then in any other parts. For, by experience 'tis found, that a Loadstone, of equal bulk, works better and more efficaciously, if it be in a long form, then if it be in any other. And, from the middle line betwixt the two poles there comes no virtue, if an iron be touch'd there: but any part towards the pole, the nearer it is to the pole, the greater party it imparts. Lastly, the declination teaches us the same; which is so much the stronger, by how much it is nearer the pole.

The



The fifth position is, that, In the loadstone there are emanations which issue, not only at the poles and about them, but also spherically, round about the whole body, & in an orb from all parts of the *superficies* of it; in such sort as happens in all other bodies whatever: And these spherical emanations are of two kinds; proportionable to the two polar emanations: And the greatest force of each sort of them is in that Hemisphere, where the Pole is, at which they make their chief issue.

The reason of the first part of this position is, because no particular body can be exempt from the Laws of all bodies: and we have above declared, that every physical body must of necessity have an orb of fluours, or a sphere of activity, about it. The reason of the second part is, that, seeing these fluours proceed out of the very substance and nature of the loadstone; they cannot choose but be found of both sorts, in every part how little soever it be, where the nature of the loadstone resides. The reason of the third part is, that, because the polar emanations tend wholly towards the poles (each of them to their proper pole); it follows that, in every Hemisphere, both those which come from the contrary Hemisphere, and those which are bred in that they go out at, are all assembled in that Hemisphere: and therefore of necessity it must be stronger in that kind of fluours, then the opposite end is. All which appears true in experience: for, if a long iron touches any part of that Hemisphere of a loadstone which tends to the North, it gains at that end a virtue of tending likewise to the North: and the same will be if an iron but hang loose over it. And this may be confirm'd, by a like experience of an iron bar, in respect of the earth; which, hanging downwards in any part of our Hemisphere, is imbued with the like inclination of drawing towards the North.

The sixth position is, that although every part of one loadstone do in it self agree with every part of another loadstone, (that is, if each of these parts were divided from their wholes, & each of them made a whole by it self, they might be so joyn'd together as they would agree); nevertheless, when the parts are in their two wholes, they do not all of them agree together: but, of two loadstones, only the poles of the one agree with the whole body of the other; that is, each pole with any part of the contrary Hemisphere of the other loadstone.

6.

The loadstone sends forth its emanations spherically. Which are of two kinds: and each kind is strongest in that Hemisphere, through whose polary parts they issue out.

7.

Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.

The flowe,



The reason of this is, because the fluours which issue out of the stones are in certain different degrees, in several parts of the entire loadstones: wherby it happens, that one loadstone can work, by a determinate part of it self, most powerfully upon the other, if some determinate part of that other lie next it; and not so well, if any other part lies towards it. And accordingly experience shews that, if you put the pole of a loadstone towards the middle of a needle that is touch'd at the point, the middle part of the needle will turn away, and the end of it will convert it self to the pole of the loadstone.

8.  
Concerning  
the declinati-  
on and other  
respects of a  
needle, to-  
wards the  
loadstone it  
touches.

The seventh position is, that, If a touched needle and a loadstone come together, and touch one another in their agreeing parts (whatever parts of them those be); the line of the needles length will bēd towards the pole of the stone (excepting, if they touch by the *Equator* of the stone, & the middle of the needle): yet not so that, if you draw out the line of the needles length, it will go through the pole of the stone; unless they touch by the end of the one, and the pole of the other. But if they touch by the *Equator* of the one and the middle of the other, then the needle will lie parallel to the *axis* of the stone.

And the reason of this is manifest; for, in that case, the two poles being equidistant to the needle, they draw it equally; and by consequence, the needle must remain parallel to the *axis* of the stone. Nor doth it import that the inequality of the two poles of the stone is, materially or quantitatively greater then the inequality of the two poles of the needle; out of which it may at the first sight seem to follow, that the stronger pole of the stone should draw the weaker pole of the needle nearer to it self, then the weaker pole of the stone can be able to draw the stronger pole of the needle; and by consequence that the needle should not lie parallel to the *axis* of the stone, but incline somewhat to the stronger pole of it. For, after you have well consider'd the matter, you will find that the strength of the pole of the stone cannot work according to its material greatness; but is confined to work only according to the susceptibility of the needle: which, being a slender and thin body, cannot receive so much as a thicker body may. Wherfore, seeing the strongest pole of the stone gives most strength to that pole of the needle, which lies furthest from it; it may well happen, that



that the superiority of strength in the pole of the needle, that is applied to the weaker pole of the stone, may counterpoise the excess of the stronger pole of the stone, over its opposite weaker pole : though not in greatness and quantity, yet in respect of the virtue which is communicable to the poles of the needle; whereby its comportment to the poles of the stone is determin'd. And indeed, the needles lying parallel to the *axis* of the stone, when the middle of it sticks to the equator of the stone, convinces that, upon the whole matter, there is no excess in the efficacious working of either of the stone's poles : but that their excess over one another, in regard of themselves, is ballanced by the needles receiving it.

But, if the needle hapen's to touch the loadstone in some part nearer one pole than the other; in this case 'tis manifest that the force of the stone is greater on the one side of the needles touch, than on the other side, because there is a greater quantity of the stone on the one side of the needle than on the other : and by consequence, the needle will incline that way which the greater force draws it; so far forth as the other part doth not hinder it. Now we know that, if the greater part were divided from the rest, and so were an entire Loadstone by it self, (that is, if the Loadstone were cut off where the needle touches it); then the needle would joyn it self to the pole, that is, to the end of that part; and by consequence, would be tending to it, as a thing that is suck'd tends towards the sucker, against the motion or force which comes from the lesser part : and on the other side, the lesser part of the stone, which is on the other side of the point which the needle touches, must hinder this inclination of the needle, according to the proportion of its strength; and so it followes, that the needle will hang by its end, not directly set to the end of the greater part, but as much inclining towards it as the lesser part doth not hinder, by striving to pull it the other way. Out of which we gather the true cause of the needles declination; to wit, the proportion of working of the two unequal parts of the stone, between which it touches and is joyn'd to the stone.

And we likewise discover their errour, who judg that the part which draws iron is the next pole to the iron. For 'tis rather the contrary pole which attracts; or, to speak more properly

8.  
The virtue of  
the Loadstone  
goes from end



to end, in  
lines almost  
parallel to  
the *Axis*.

properly 'tis the whole body of the stone, as streaming in lines almost parallel to the *axis*, from the furthestmost end, to the other next the iron: and (in our case) 'tis that part of the stone, which begins from the contrary pole and reaches to the needle. For, besides the light which this discourse gave us, experience assures us, that a Loadstone, whose poles lie broadways, not longways, is more imperfect and draws more weakly then if the poles lay longways; which would not be, if the fluours stream'd from all parts of the stone directly to the pole: for then, however the stone were cast, the whole virtue of it would be in the poles. Moreover, if a needle were drawn freely upon the same *Meridian*, from one pole to the other; as soon as it were pass'd the *Equator*, it would leap suddenly, at the very first remove of the *Equator* where 'tis parallel with the *axis* of the Loadstone, from being so parallele, to make an angle with the *axis*, greater then a half right one; to the end that it might look upon the pole, which is supposed to be the only attractive that draws the needle: which great change, wrought all at once, nature never causes nor admits, but, in all actions or motions, uses to pass through all the *Mediums*, whenever it goes from one extreme to another. Besides, there would be no variation of the needles aspect towards the North end of the stone: for, if every part sent its virtue immediately to the poles, it were impossible that any other part whatever should be stronger then the polar part, seeing that the polar part has the virtue even of that particular part, and of all the other parts of the stone beside, joyn'd in it self.

This therefore is evident, that the virtue of the loadstone goes from end to end in parallel lines; unless it be in such stones, as have their polar parts narrower then the rest of the body of the stone: for, in them, the stream will tend with some little declination towards the pole, as it were by way of refraction. Because, without the stone, the fluours from the pole of the earth coarct themselves, and so thicken their stream, to croud into the stone, as soon as they are sensible of any emanations from it; that being (as we have said before) their readiest way to pass along: and with in the stone, the stream doth the like, to meet the adventient stream where it is strongest and thickest; which is at that narrow part of the stones end, which is most prominent out.

And



And, by this discourse, we discover likewise another error, of them that imagine the Loadstone hath a sphere of activity round about it, equal on all sides; that is, perfectly spherical, if the stone be spherical. Which clearly is a mistaken speculation: for, nature having so order'd all her agents, that where the strength is greatest, there the action must (generally speaking) extend it self furthest off; and it being acknowledg'd that the Loadstone hath greatest strength in its Poles, and least in the Equator; it must of necessity follow, that it works further by its Poles, than by its Equator. And consequently, it is impossible that its sphere of activity should be perfectly spherical.

Nor doth *Cabeus* his experience move us, to conceive the loadstone hath a greater strength to retain an iron laid upon it by its Equator, than by its Poles: for, to justify his assertion, he should have tried it in an iron wire, that were so short as the poles could not have any notable operation upon the ends of it; since otherwise, the force of retaining it will be attributed to the Poles (according to what we have above deliver'd) and not to the Equator.

The eighth position is, that The intention of nature, in all the operations of the Loadstone, is to make an union betwixt the attractive and the attracted bodies. Which is evident out of the sticking of them together: as also out of the violence wherewith iron comes to a Loadstone; which, when it is drawn by a powerful one, is so great, that, through the force of the blow hitting the stone, it will rebound back, and then fall again to the stone. And, in like manner, a needle upon a pin, if a Loadstone be set near it, turns with so great a force towards the pole of the stone, that it goes beyond it and, coming back again, the celerity wherewith it moves maketh it retire it self too far on the other side; and so, by many undulations, at last it comes to rest directly opposite to the pole. Likewise, by the declination; by means of which, the iron to the stone, or the stone to the earth, approaches in such a disposition, as is most convenient to joyn the due ends together. And lastly, out of the flying away of the contrary ends from one another: which clearly is to no other purpose, but that the due ends may come together. And in general, there is no doubt, but ones going to another is instituted by the order of nature for their coming together; and for their being together, which is but a perseverance of their coming together.

10.

The virtue of the Loadstone is not perfectly spherical, though the stone be such.

11.

The intention of nature, in all the operations of the loadstone, is to make an union betwixt the attractive and attracted bodies.

The



12.  
The main  
globe of the  
earth is not a  
Loadstone.

The ninth position is, that, The nature of a Loadstone doth not sink deeply into the main body of the earth, as to have the substance of its whole body be magnetical; but only remains near the surface of it. And this is evident, by the inequality in virtue of the two ends: for, if this magnetick virtue were the nature of the whole body, both ends would be equally strong; For would the disposition of one of the ends be different from the disposition of the other. Again, there could be no variation of the tending towards the North: for, the bulk of the whole body would have a strength so eminently greater then the prominences and disparities of hills or seas, as the varieties of these would be absolutely insensible. Again, if the motion of the Loadstone came from the body of the earth, it would be perpetually from the *center*, & not from the Poles; & so, there could be no declination more in one part of the earth, then in another. Nor would the Loadstone tend from North to South, but from the *centre* to the *circumference*; or rather from the *circumference* to the *centre*. And so we may learn the difference between the loadstone and the earth, in their attractive operations; to wit, that the earth doth not receive its influence from another body, nor doth its magnetick virtue depend of another magnetick agent, that impresses it into it: which, nevertheless, is the most remarkable condition of a Loadstone. Again, the strongest vertue of the Loadstone is from pole to pole; but the strongest virtue of the earth is from the centre upwards: as appears by fireforks, gaining a much greater magnetick strength in a short time, then a Loadstone in a longer. Neither can it be thence objected, that the loadstone should therefore receive the earths influences more strongly from the centerwards, then from the poles of the earth, (which by its operation, and what we have discours'd of it, is certain it doth not): since the beds, where Loadstones lie and are form'd, be towards the bottome of that part or back of the earth which is imbued with magnetick virtue. Again, this virtue which we see in a Loadstone is substantial to it; whereas the like virtue is but accidental to the earth, by means of the Suns drawing the northern and southern exhalations to the Equator.

13.  
The loadstone  
is generated  
in all parts or  
Climats of  
the earth.

The last position is, that The loadstone must be found over all the earth, and in every country. And so we see it is: both because iron mines are found (in some measure) almost in all countries; & because,



cause, at least other sorts of the earth (as we have declared of potearths) cannot be wanting in any large extent of country, which, when they are baked and cool'd in due positions, have this effect of the Loadstone, and are of the nature of it. And *Dr. Gilbert* shews, that the loadstone is nothing else but the Ore of Steel or perfectest iron, and that it is to be found of all colours, and fashions, and almost of all consistences.

So that we may easily conceive, that the emanations of the Loadstone being every where, as well as the causes of gravity; the two motions, of magnetick and weighty things, both of them derive their origine from the same source: I mean, from the very same emanations coming from the earth; which by a divers ordination of nature, make this affect in the loadstone, and that other in weighty things. And, who knows but that a like sucking, to this which we have shew'd in magnetick things, passes also in the motion of gravity? in a word, gravity bears a fair testimony in behalf of the magnetick force; and the Loadstones working returns no mean verdict for the causes of gravity: according to what we have delivered of them.

14.  
The consequence  
betwixt  
the two motions  
of magnetick things,  
and of heavy things.

## CHAP. XXII.

*A Solution of certain Problemes concerning the Loadstone, and a short sum of the whole doctrine touching it.*

Of what is said upon this subject, we may proceed to the Solution of certain questions or problemes, which are or may be made in this matter. And first, of that which *Dr. Gilbert* disputes, against all former writers of the Loadstone; to wit, which is the North, and which the South pole of a stone? Which seems to me only a question of the name: for if, by the name of North and South, we understand that end of the stone which has that virtue that the North or South pole of the earth have then 'tis certain, that the end of the stone which looks to the South pole of the earth is to be called the North pole of the loadstone, and contrariwise, that which looks to the North is to be called the South pole of it. But if, by the names of North and South pole of the stone, you mean those ends of it, that lie and point to the North and South poles of the earth; then you

1.  
Which is the  
North, and  
which the  
South Pole of  
a Loadstone.

Q

must



must reckon their poles contrariwise to the former account. So that, the terms being once defined, there will remain no further controversie about the point.

2.  
Whether any  
bodies, besides  
magnetick  
ones, be attra-  
ctive.

Dr. *Gilbert* seems also to have another controversie with all Writers; to wit, whether any bodies besides Magnetical ones be attractive; Which he seems to deny; all others to affirm. But this also, being fairly put, will peradventure prove no controversie: for the question is either in common, of attraction, or else in particular, of such an attraction as is made by the loadstone. Of the first part, there can be no doubt; as we have declared above; and is manifest betwixt gold and quicksilver, when a man holding Gold in his mouth, it draws to it the quicksilver that is in his body. But, for the attractive to draw a body to it self, not wholly, but one determinate part of the body drawn, to one determinate part of the drawer; is an attraction which, for my part, I cannot exemplifie in any other bodies but Magnetical ones.

3.  
Whether an  
iron, placed  
perpendicu-  
larly towards  
the earth, gets  
a magnetical  
virtue of  
pointing to-  
wards the  
north, or to-  
wards the  
south, in that  
end that lies  
downwards.

A third question is, Whether an iron that stands long unmoved in a window, or any other part of a building, perpendicularly to the earth, contracts a Magnetical virtue, of drawing or pointing towards the North, in that end which looks downwards? For *Cabeus* (who wrote since *Gilbert*) affirms it out of experience: but, either his experiment or his expression was defective. For, assuredly, if the iron stands so in the Northern Hemisphere, it will turn to the North; and, if in the Southern Hemisphere, it will turn to the South: for, seeing the virtue of the loadstone proceeds from the earth, and the earth has different tempers towards the North, and toward the South pole (as hath been already declared); the virtue, which comes out of the earth in the Northern Hemisphere, will give to the end of the iron next it an inclination to the North pole, and the earth of the Southern Hemisphere will yield the contrary disposition to the end which is nearest it.

4.  
Why load-  
stones affect  
iron better  
than one ano-  
ther.

The next Question is, why a loadstone seems to love iron better than another loadstone? The answer is, because iron is indifferent in all its parts to receive the impression of a loadstone; whereas another loadstone receives it only in a determinate part: and therefore a loadstone draws iron more easily than it can another loadstone; because it finds repugnance in



in the parts of another Loadstone, unless it be exactly situated in a right position. Besides, iron seems to be compared to a Loadstone, like a more humid body to a dryer of the same nature: and the difference of male and female sexes in Animals manifestly shew the great appetite of conjunction between moisture and dryness, when they belong to bodies of the same species.

Another question is that great one, Why a Loadstone cap'd with steel takes up more iron, than it would do if it were without that caping? Another conclusion like this is, that, if by a Loadstone you take up an iron, and by that iron a second iron, and then pull away the second iron; the first iron (in some position) will leave the Loadstone to stick to the second iron, as long as the second iron is within the sphere of the Loadstones activity: but, if you remove the second out of that sphere, then the first iron remaining within it, though the other be out of it, will leave the second, and leap back to the Loadstone. To the same purpose is this other conclusion; that, The greater the iron is, which is entirely within the compass of the Loadstones virtue, the more strongly the Loadstone will be moved to it, and the more forcibly stick to it.

5.  
Gilberts  
reason refused  
touching a  
cap'd Load-  
stone, that  
takes up more  
iron than one  
not cap'd;  
and an iron  
impregnated  
that, in some  
case, draws  
more strongly  
than the stone  
it self.

The reasons of all these three we must give at once: for, they hang all upon one string. And, in my conceit, neither *Gilbert* nor *Galileo* have hit upon the right. As for *Gilbert*; he thinks that, in iron, there is originally the virtue of the loadstone; but that it is as it were asleep, till by the touch of the Loadstone it be awaked and set on work: and therefore the virtue of both joyn'd together is greater, than the virtue of the Loadstone alone.

But, if this were the reason, the virtue of the iron would be greater in every regard; and not only in sticking or in taking up: whereas himself confesses, that a cap'd stone draws no further than a naked stone, nor hardly so far. Besides, it would continue its virtue out of the sphere of activity of the loadstone; which it doth not. Again, seeing that, if you compare them severally, the virtue of the Loadstone is greater, than the virtue of the iron; why should not the middle iron stick closer to the stone, than to the further iron, which must of necessity have less virtue?

*Galileo* yeelds the cause of this effect, that, when an iron



Galileus his  
opinion  
touching the  
former effects  
refuted.

touches an iron, there are more parts which touch one another, then when a Loadstone touches the iron: First, because the Loadstone hath generally much impurity in it, and therefore divers parts of it have no virtue: whereas iron by being melted hath all its parts pure: and secondly, because iron can be smooth'd and polish'd more then a Loadstone can be, and therefore its *superficies* touches, in a manner, with all its parts: whereas divers parts of the stones *superficies* cannot touch, by reason of its ruggedness.

And he confirms his opinion by experience: for, if you put the head of a needle to a bare stone, and the point of it to an iron; and then pluck away the iron; the needle will leave the iron and stick to the stone; but, if you turn the needle the other way, it will leave the stone and stick to the iron. Out of which he infers that 'tis the multitude of parts, which causes the close and strong sticking. And it seems he found the same in the caping of his Loadstones; for he used flat irons for that purpose, which by their whole plane did take up other irons: whereas Gilbert cap'd his with convex irons; which, not applying themselves to other irons, so strongly or with so many parts as Galileo's did, would not by much take up so great weights as his.

Nevertheless, it seems not to me that his answer is sufficient, or that his reasons convince. For, we are to consider that the virtue, which he puts in the iron, must (according to his own supposition) proceed from the Loadstone: and then, what imports it, whether the *superficies* of the iron, which touches another iron, be so exactly plain or no, or that the parts of it be more solid then the parts of the stone? For, all this conduces nothing to make the virtue greater then it was: since no more virtue can go from one iron to the other, then goes from the Loadstone to the first iron; and, if this virtue cannot tie the first iron to the Loadstone, it cannot proceed out of this virtue that the second iron be tyed to the first. Again, if a paper be put betwixt the cap and another iron, it doth not hinder the magnetical virtue from passing through it to the iron; but the virtue of taking up more weight, then the naked stone was able to do, is thereby render'd quite useless. Therefore, 'tis evident, that this virtue must be put in something else, and not in the application of the magnetical virtue.

And



And, to examine his reasons particularly : it may very well fall out, that, whatever the cause be, the point of a needle may be too little to make an exact experience in; and therefore a new doctrine ought not lightly be grounded upon what appears in the application of that. And likewise, the greatness of the surfaces of the two irons may be a condition helpful to the cause, whatever it be : for, greater and lesser are the common conditions of all bodies, and therefore avail all kinds of corporeal causes ; so that no one cause can be affirm'd more than another, meerly out of this, that great doth more, and little doth less.

To come then to our own solution. I have consider'd how fire hath, in a manner, the same effect in iron, as the virtue of the Loadstone hath by means of the cap : for, I find that fire, coming through iron red-glowing hot, will burn more strongly, then if it should come immediatly through the air ; also we see that, in Pitcole, the fire is stronger then in Charcole. And nevertheless, the fire will heat further if it come immediately from the source of it, then if it come through a red iron that burns more violently where it touches ; and likewise charcoal will heat farther then pitcoal, that near hand burns more fiercely. In the same manner, the Loadstone will draw further without a cap then with one ; but with a cap it sticks faster then without one. Whence I see that it is not purely the virtue of the Loadstone ; but the virtue of it being in iron, which causes this effect.

Now, this modification may proceed, either from the multitude of parts which come out of the Loadstone, and are as it were stop'd in the iron, & so the sphere of their activity becomes shorter, but stronger ; or else, from some quality of the iron, joyn'd to the influence of the loadstone. The first seems not to give a good account of the effect : for, why should a little paper take it away, seeing we are sure that it stops not the passage of the loadstones influence ? Again, the influence of the Loadstone seems in its motion to be of the nature of light, which goes in an insensible time as far as it can reach : and therefore, were it multiply'd in the iron, it would reach further then without it ; and from it the virtue of the Loadstone would begin a new sphere of activity. Therefore we more willingly cleave to the latter part of our determination.

Q 3

And

7.  
The Authors  
solution to  
the former  
questions.



And therupon enquiring what quality there is in iron, whence this effect may follow; we find, that it is distinguish'd from a loadstone, as a metal is from a stone. Now, we know that metals have generally more humidity than stones: and we have discour'd above, that humidity is the cause of sticking; especially when it is little and dense. These qualities must needs be in iron, which of all metals is the most terrestrial: and such humidity as is able to stick to the influence of the loadstone, as it passes through the body of the iron, must be exceeding subtile and small. And it seems necessary that such humidity should stick to the influence of the loadstone, when it meets with it, considering that the influence is of it self dry, and that the nature of iron is a kin to the loadstone: wherfore the humidity of the one, & the drought of the other, will not fail of incorporating together. Now then, if two irons, well polish'd and plain, be united by such a glew as results out of this composition; there is a manifest appearance of much reason for them to stick strongly together. This is confirm'd by the nature of iron in very cold Countreys and very cold weather: for the very humidity of the air, in times of frost, will make upon iron, sooner then upon other things, such a sticking glew as will pull off the skin of a mans hand that touches it hard.

And, by this discourse, you will perceive that *Galileo's* arguments confirm our opinion, as well as his own; and that, according to our doctrine, all circumstances must fall out just as they do in his experiences. And the reason is clear, why the interposition of another body hinders the strong sticking of iron to the cap of the loadstone; for, it makes the mediation between them greater; which we have shew'd to be the general reason why things are easily parted.

Let us then proceed to the resolution of the other cases proposed. The second is already resolv'd: for, if this glew be made of the influence of the loadstone, it cannot have force further then the loadstone it self has; and so far it must have more force then the bare influence of the loadstone. Or rather the humidity of two irons makes the glew of a fitter temper to hold, then that which is between a dry loadstone and iron: and the glew enters better when both sides are moist, then when only one is so.

But



But this resolution, though it be in part good, yet doth not evacuate the whole difficulty; since the same case happens between a stronger and a weaker Loadstone, as between a Loadstone and iron: for, the weaker Loadstone, while it is within the sphere of activity of the greater Loadstone, draws away an iron set betwixt them, as well as a second iron doth. For the reason, therefore, of the little Loadstones drawing away the iron, we may consider, that the greater Loadstone hath two effects upon the iron betwixt it and a lesser Loadstone; and a third effect upon the little loadstone it self. The first is, that it impregnates the iron, and gives it a permanent vertue, by which it works like a weak Loadstone. The second is, that, as it makes the iron work towards the lesser Loadstone by its permanent vertue; so also it accompanies the steam that goes from the iron towards the little Loadstone, with its own steam which goes the same way: so that both these steams in company climb up the steam of the little Loadstone which meets them; and that steam climbs up the enlarged one of both theirs together. The third effect which the greater Loadstone works is, that it makes the steam of the little loadstone become stronger, by augmenting its innate vertue in some degree.

Now then, the going of the iron to either of the Loadstones must follow the greater and quicker conjunction of the two meeting steams, and not the greatness of one alone. So that, if the conjunction of the two steams, between the iron and the little Loadstone, be greater & quicker, then the conjunction of the two steams, which meet betwixt the greater Loadstone and the iron; the iron must stick to the lesser Loadstone. And this must happen more often then otherwise: for, the steam which goes from the iron to the greater Loadstone will, for the most part, be less then the steam which goes from the lesser Loadstone to the iron; & though the other steam be never so great, yet it cannot draw more then according to the proportion of its *Antagonists* coming from the iron: Wherefore, seeing the two steams betwixt the iron and the little Loadstone are more proportionable to one another; and the steam coming out of the little loadstone is notably greater then the steam going from the iron to the greater Loadstone: the conjunction must be made, for the most part, to the little loadstone. And, if this discourse doth not

8.

The reason why, in the former case, a lesser Loadstone draws the interjacent iron from the greater.



hold in the former part of the Probleme, betwixt a second iron and Loadstone; it is supplied by the former reason which we gave for that particular purpose.

The third case depends also of this solution: for, the bigger an iron is, so many more parts it hath to suck up the influence of the Loadstone, and consequently, doth it thereby the more greedily; and therefore the Loadstone must be carried to it more violently and, when they are joyn'd, stick more strongly.

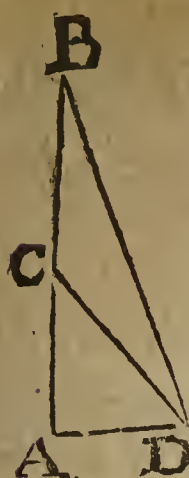
9.  
Why the variation of a touched needle from the North is greater, the nearer you go to the Pole;

The sixth question is, Why the variations of the Needle from the true North, in the Northern Hemisphere, are greater the nearer you go to the Pole, and lesser the nearer you approach to the *Equator*. The reason wherof is plain in our doctrine. For, considering that the magnetick virtue of the earth streams from the North towards the *Equator*; it follows of necessity, that, if there be two streams of magnetick flows issuing from the North, one of them precisely from the pole, & the other from a part of the earth near the pole, & that the stream coming from the point by side the Pole be but a little the stronger of the two; there will appear very little differences in their several operations, after they have had a long space to mingle their emanations together, which thereby join and grow as it were into one stream: whereas, the nearer you come to the Pole, the more you will find them severed, and each of them working by its own virtue. And, very near the point which causes the variation, each stream works singly by it self; and therefore here the point of variation must be master, and will carry the needle strongly to his course from the due North, if his stream be never so little more efficacious then the other.

Again, a line drawn from a point of the Earth wide of the Pole, to a point of the *Meridian* near the *Equator*, makes a less angle; then a line drawn from the same point of the Earth, to a point of the same *Meridian* nearer the Pole: wherefore, the variation being esteem'd by the quantities of the said angles, it must needs be greater near the Pole, then near the *Equator*; though the cause be the same.

Which a little figure will presently explicate. Let the point A be the Pole, and the line A B the *Meridian*, and the point B the intersection of it, with a parallel near the *Equator*, and the point C the intersection of the *Meridian* with the *Tropic*;





pick ; and D a point in the Earth near the Pole, to which, in the said intersection, the needle tends, instead of looking directly to the pole, whereby it makes variation from due North. I say then, that the variation of a needle near the Equator in the point B, looking upon the point D, cannot be so great and sensible, as the variation of a needle in the Tropick C, looking upon the same point : since the angle DBA, which is made by the variation of the first, is less then the angle DCA, which it made by the variation of the latter needle, - neerer the Pole,

But, because it may happen, that, in the parts near the Equator, the variation may proceed from some piece of land, not much more northerly then where the needle is, but that it bears rather Easterly or Westerly from it, and yet *Gilbert's* assertion goes universally, when he says the variations in Southern regions are less then in Northern ones: we must examine what may be the reason thereof. And presently, the generation of the Loadstone shews it plainly. For, seeing the nature of the Loadstone proceeds out of this, that the Sun works more upon the Torrid Zone, then upon the poles ; and that his too strong operation is contrary to the Loadstone, as being of the nature of fire : it follows evidently, that the lands of the Torrid Zone cannot be so magnetical (generally speaking) as the polar lands are ; and by consequence, that a lesser land near the Pole will have a greater effect, then a larger continent near the Equator ; and likewise, a land further off towards the Pole will work more strongly, then a nearer land which lies towards the Equator.

The seventh question is, Whether, in the same part of the world, a touched needle may at one time vary more from the true North point, and at another time less? In which *Gilbert* was resolute for the negative part: but our latter Mathematicians are of another mind. Three experiences were made neer London in three divers years ; The two first 42 years distant from one another, and the third 12 years distant from the second. And by them it is found that, in the space of 54 years, the Loadstone hath, at London, diminish'd his variation from the North, the quantity of 7 degrees and more ; But so that, in the latter years, the diminution hath sensibly gone faster then in the former.

These

10.  
Whether, in the same part of the world a touched needle at one time vary more from the North, and at another time less.



These observations, peradventure, are but little credited by Strangers; but we, who know the worth of the men that made them, cannot mistrust any notable error in them: for they were very able Mathematicians, and made their observations with very great exactness; and there were several judicious witnesses at the making of them; as may be seen in *Mr. Gillebrand's* print concerning this subject. And divers other particular persons confirm the same; whose credit, though each single might peradventure be slighted, yet all in body make a great accession.

We must therefore cast about to find what may be the cause of an effect so paradox to the rest of the doctrine of the Loadstone: for seeing that no one place can stand otherwise to the North of the earth at one time then at another; how it is possible the needle should receive any new variation, since all variation proceeds out of the inequality of the earth? But, when we consider that this effect proceeds not out of the main body of the earth, but only out of the bark of it; and that its bark may have divers tempers, not as yet discover'd to us; out of whose variety the influence of the earthy parts may be divers in respect of one certain place: 'tis not impossible but that such variation may be, especially in *England*; which Island lying open to the North, by a great and vast Ocean, may receive, more particularly then other places, the special influences and variation of the weather, that happen in those Northeastern countreys from whence this influence comes to us. If therefore there should be any cours of weather, whose period were a hundred years (for example), or more or lesse, and so might easily pass unmarked: this variation might grow out of such a cours.

But, in so obscure a thing, we have already hazarded to guess too much. And, upon the whole matter of the Loadstone, it serves our turn, if we have proved (as we conceive we have done fully) that its motions, which appear so admirable, do not proceed from an occult quality: but that the causes of them may be reduced to local motion; and all perform'd by such corporeal instruments and means (though peradventure more intricately disposed) as all other effects are among bodies. Whose ordering and disposing and particular progress there



there is no reason to despair of finding out; would men but carefully apply themselves to that work, upon solid principles and with diligent experiences.

But because this matter has been very long, and scatteringly diffused in many several branches; peradventure it will not be displeasing to the Reader, to see the whole nature of the loadstone sum'd up in short. Let him then cast his eyes upon one effect of it, very easie to be tried, and acknowledg'd by all writers; though we have not as yet mention'd it: 'Tis, that a knife, drawn from the pole of a loadstone towards the Equator, if you hold the point towards the pole, gains a respect to one of the poles; but contrariwise, if the point of the knife be held towards the Equator, and be thrust the same way it was drawn before (that is, towards the Equator), it gains a respect towards the contrary pole.

II.  
The whole  
doctrine of the  
loadstone  
sum'd up in  
short.

'Tis evident out of this experience, that the virtue of the loadstone is communicated by way of streams; and that in it there are two contrary streams: for otherwise the motion of the knife, this way or that way, could not change the efficacy of the same parts of the loadstone. 'Tis likewise evident, that these contrary streams come from the contrary ends of the loadstone. As also, that the virtues of them both are in every part of the stone. Likewise, that one loadstone must of necessity turn certain parts of it self, to certain parts of another loadstone; nay, that it must go and joyn to it, according to the laws of attraction which we have above deliver'd: and consequently, that they must turn their disagreeing parts away from one another; and so one loadstone seem to fly from another; if they be so apply'd that their disagreeing parts be kept still next to one another; for, in this case, the disagreeing and the agreeing parts of the same loadstone being in the same straight line; one loadstone, seeking to draw his agreeing part near to that part of the other loadstone which agrees with him, must of necessity turn away his disagreeing parts, to give way to his agreeing parts to approach nearer,

And thus you see, that the flying from one another of two ends of two loadstones, which are both of the same denomination, (as for example, the two South ends, or the two North ends), doth not proceed from a pretended antipathy between those



those two ends, but from the attraction of the agreeing ends.

Furthermore, the earth having to a Loadstone the nature of a Loadstone; it follows that a Loadstone must necessarily turn it self to the poles of the earth, by the same laws: and consequently, must tend to the North, must vary from the North, must incline towards the *centre*; and must be affected with all such accidents as we have deduced of the Loadstone.

And lastly, seeing that iron is to a Loadstone a fit matter for it to impress its nature in, and easily retains that magnetike virtue; the same effects, that follow between two Loadstones, must necessarily follow between a Loadstone and a piece of iron, fitly proportionated in their degrees: excepting some little particularities, which proceed out of the naturalness of the magneticke virtue to a Loadstone, more then to iron.

And thus you see the nature of the Loadstone sum'd up in gross; the particular joynts and causes whereof, you may find treated at large in the main discourse. Wherin we have govern'd our selves chiefly by the experiences that are recorded by *Gilbert* and *Cabeus*; to whom, we remit our Reader for a more ample declaration of particulars.

### CHAP. XXIII.

*A description of the two sorts of Living Creatures, Plants and Animals: and how they are framed in common, to perform vital motion.*

I.  
The connexion of the following Chapters with the precedent ones.

**H**itherto we have endeavour'd to follow, by a continual third, all such effects as we have met with among Bodies; and to trace them in all their windings, and drive them up to their very root & original source: for, the nature of our subject, having been yet very common, hath not exceeded the compass and power of our search & inquiry, to descend to the chief circumstances and particulars belonging to it. And indeed, many of the conveyance, wherby the operations we have discoursed of are performed, be so secret and abstruse; as they that Look into them, with less heedfulness and judgment then such a matter requires, are too apt to impute them to mysterious causes, above the reach of humane nature to comprehend, and to calumniate them of being wrought by occult and specifick qua-



qualities, wherof no more reason could be given, then if the effects were infused by Angelical hands, without assistance of inferiour bodies; which uses to be the last refuge of ignorant men; who, not knowing what to say, and yet presuming to say something, fall often upon such expressions, as neither themselves nor their hearers understand, but if they be well scan'd, imply contradictions. Therefore, we deem'd it a kind of necessity, to strain our selves to prosecute most of such effects; even to their notional connexions with Rarity and Density. And the rather, because it hath not been our luck yet to meet with any that has had the like design, or done any considerable matter to ease our pains. VVhich cannot but make the Readers journey somewhat tedious to him, to follow all our steps; by reason of the ruggedness and untroddenness of the paths we have walk'd in.

But now, the effects we shall henceforward meddle with grow so particular, and swarm into such a vast multitude of several little joynts and wreathy labyrinths of nature; as were impossible, in so summary a treatise as we intend, to deliver the causes of every one of them exactly: which would require both large discourses, and abundance of experiences, to acquit our selves as we ought of such a task. Nor is there a like need of doing it as formerly, for as much as concerns our design; since the causes of them are palpably material, and the admirable artifice of them consists only in the *Dedalean* and wonderful-ingenious ordering and ranging them one with another.

VVe shall therefore intreat our Reader, from this time forwards, to expect only the common sequel of those particular effects, out of the principles already laid. And when some shall occur, that may peradventure seem at first sight enacted immediately by a virtue spiritual, and that proceeds indivisibly; in a different strain from the ordinary process which we see in bodies and bodily things (that is, by the virtues of *rarity* and *density*, working by *local motion*): we hope he will be satisfied at our hands, if we lay down a method, and trace out a course, wherby such events and operations *may* follow out of the principles we have laid. Though peradventure we shall not absolutely convince, that every effect is done just as we set it down in every particular; and that it may not as well be done



done by some other disposing of parts under the same general scope: for 'tis enough for our turn, if we shew that such effects may be perform'd by corporeal agents, working as other bodies do, without confining our selves to an exactness, in every link of the long chain that must be wound up in the performance of them.

2.  
Concerning  
several com-  
positions of  
mixed bodies.

To come then to the matter. Now that we have explicated the natures of those motions, by means wherof bodies are made and destroy'd; and in which they are to be consider'd chiefly as passive, whiles some exterior agent, working upon them, causes such alterations in them, and brings them to such pass, as we see in the changes that are daily wrought among substances: The next thing we are to imploy our selves about is, to take a survey of those motions which some bodies have, wherein they seem to be not so much patients as agents, and contain within themselves the principle of their own motion, having no relation to any outward object, more then to stir up that principle of motion and set it on work; which, when it is once in act, hath, as it were within the limits of its own kingdom and sever'd from commerce with all other bodies whatever, many other subaltern motions over which it presides.

To which purpose we may consider, that, among the compounded bodies, whose natures we have explicated, there are some, in whom the parts of different complexions are so small & so well mingled together, that they make a compound which, to our sense, seems all quite through of one Homogeneous nature; and, however it be divided, each part retains the entire and compleat nature of the whole. Others again there are, in which 'tis easie to discern that the whole is made up of several great parts, of very differing natures and tempers.

And of these there are two kinds: one, of such as their differing parts seem to have no relation to one another, or correspondence together to perform any particular work, in which all of them are necessary, but rather they seem to be made what they are by chance and accident; and, if one part be sever'd from another, each is an entire thing by it self, of the same nature as it was in the whole, and no harmony is destroy'd by such division. As may be observ'd in some bodies dig'd out of Mines, in which one may see lumps of Metal, or stone,  
and



and glass, and such different substances, in their several distinct situations, perfectly compacted into one continue body; which if you divide, the glass remains what it was before, the Emerald is still an Emerald, the silver is good silver, and the like of the other substances: the causes of which may be easily deduced, out of what we have formerly said. But, there are other bodies, in which this manifest and notable difference of parts carries with it such a subordination of one of them to another, as we cannot doubt but that nature made such engines (if so I may call them) by design, and intended that this variety should be in *One thing*; whose unity and being what it is, should depend of the harmony of the several differing parts, and should be destroy'd by their separation. As we see in *living Creatures*, whose particular parts and members being once sever'd, there is no longer a living creature to be found among them.

Now, of this kind of bodies there are two sorts. The first is of those that seem to be one continue substance, wherein we may observe one and the same constant progress throughout, from the lowest to the highest part of it; so that the operation of one part is not at all different from that of another: but the whole body seems to be the course and throughfare of one constant action, varying it self in divers occasions and occurrences, according to the disposition of the subject.

3.  
Two sorts of  
Living Crea-  
tures.

The bodies of the second sort have their parts so notably separated one from the other, and each have such a peculiar motion proper to them, that one might conceive they were every one a complete distinct total thing by it self, and that all of them were artificially tied together: were it not that the subordination of these parts to one another is so great, and the correspondence between them so strict, (the one not being able to subsist without the other, from whom he derives what is needful for him; and again, being so useful to that other, and having its action and motion so fitting and necessary for it, as without it that other cannot be), as plainly convinces that the compound of all these several parts must needs be one individuol thing.

I remember that, when I travel'd in *Spain*, I saw there two Engines that, in some sort, express the natures of these two kinds of bodies; One at *Toledo*, the other a *Segovia*: both

4.  
An engine to  
express the  
first sort of li-  
ving creatures  
of.



of them set on work by the current of the river in which the foundation of their machine was laid. That at *Toledo* was to force up water at a great height, from the river *Tagus* to the *Alcazar* (the Kings palace), that stands upon a high steep hill or rock, almost perpendicular over the river. In the bottome there was an indented wheel, which, turning round with the stream, gave motion at the same time to the whole engine; which consisted of a multitude of little troughs or square ladles, set one over another in two parallel rows over against one another, from the bottom to the top, and upon two several divided frames of timber. These troughs were closed at one end with a traverse board, to retain the water from running out there; which end, being bigger then the rest of the trough, made it somewhat like a ladle; and the rest of it seem'd to be the handle with a channel in it; the little end of which channel or trough was open, to let the water pass freely away. And these troughs were fasten'd by an axletree in the middle of them, to the frame of timber that went from the bottome up to the top: so that they could upon that center move at liberty, either the shut end downwards, or the open end; like the beam of a balance.

Now, at a certain position of the root-wheel (if so I may call it), all one side of the machine sunk down a little lower towards the water; and the other was raised a little higher: Which motion was changed, as soon as the ground-wheel had ended the remnant of his revolution; for then the side that was lowest before sprung up, and the other sunk down: And thus the two sides of the machine were like two legs, that by turns trod the water; as in the Vintage men press Grapes in a watte. Now, the troughs, that were fast'ned to the timber which descended, turn'd that part of them downwards which was like a Box shut to hold the water; and consequently, the open end was up in the air, like the arm of the ballance to which the lightest scale is fasten'd: and in the mean time, the troughs upon the ascending timber were moved by a contrary motion, keeping their box-ends aloft, and letting the open ends incline downwards; so that, if any water were in them, they would let it run out, wher'as the others retain'd any that came into them.

VWhen you have made an image of this Machine in your phantasie,



phantasie, consider what will follow out of its motion. You will perceive that, when one leg sinks down towards the water, that trough which is next to the *Superficies* of it, putting down his box end and dipping it a little in the water, must needs bring up as much as it can retain, when that leg ascends: which when it is at its height, the trough moves upon his own centre, & the box end, which was lowest, becomes now highest; and so the water runs out of it. Now, the other leg descending at the same time, it falls out that the trough on its side, which would be a step above that which hath the water in it if they stood in equilibrium, becomes now a step lower than it; and is so placed, that the water, which runs out of that which is aloft, falls into the head or box of it: which no sooner hath receiv'd it, but that leg on which it is fastned springs up, and the other descends; so that the water of the second leg runs now into the box of the first leg, that is next above that which first laded the water out of the river. And thus, the troughs of the two legs deliver their water by turns from one side to the other; and at every remove, it gets a step upwards, till it comes to the top: while at every ascent and descent of the whole side, the lowest ladle or trough takes new water from the River; which ladleful follows immediately in its ascent that which was taken up the time before. And thus, in a little while, all the troughs from the bottom to the top are full; unless there happen to be some failing in some ladle: and in that case the water breaks out there, and all the ladles above that are dry.

The other Engine, or rather multitude of several engines, to perform sundry different operations, all conducing to one work (whereas, that of *Toledo* is but one tenour of motion, from the first to the last,) is in the Mint at *Segovia*. Which is so artificially made, that one part of it distends an Ingot of Silver or Gold, into that breadth and thickness as is requisite to make Coyn of. Which being done, it delivers the plate it has wrought to another, that Prints the Figure of the Coyn upon it. And from thence it is turn'd over to another, that cuts it according to the Print, into due shape and weight. And lastly, the several pieces fall into a reserve, in another room: where the Officer, whose charge it is, findes Treasure ready Coyned; without any thing there, to inform him of the several

R

diffe-

<sup>S.</sup>  
Another Engine by which may be expressed the second sort of living creatures.



different motions that the silver or the gold passed, before they came to that state. But, if he go on the other side of the wall, into the room where the other machines stand and are at work; he will then discern that every one of them, which consider'd by it self might seem a distinct complete engine, is but a serving part of the whole, whose office is to make money: and that, for this work any one of them, separated from the rest, ceases to be the part of a mint, and the whole is maim'd and destroy'd.

4  
The two former engines and some other comparisons applied, to express the two several sorts of living creatures.

Now, let us apply the consideration of these different kinds of Engines to the natures of the bodies we treat of. Which, I doubt not, would fit much better, were they lively and exactly described: But it is so long since I saw them, and I was then so very young, that I retain but a confus'd and cloudy remembrance of them, Especially, of the mint at *Segovia*, in the which there are many more particulars then I have touch'd; as, conveniency for refining the ore or metal, and then casting it into ingots, and driving them into rods, and such like: to all which there is little help of hands requisite, more then to apply the matter duly at the first. But, what have I said of them is enough, to illustrate what I aim at; and though I should erre in the particulars, 'tis no great matter; for, I intend not to deliver the history of them; but only, out of the remembrance of such notable and artificial masterpieces, to frame a model, in their phancies that shall read this, of something like them, wherby they may, with more ease, make a right conception of what we are handling.

Thus then, all sorts of plants, both great and small, may be compared to our first engine of the waterwork at *Toledo*. For in them all the motion, we can discern, is of one part transmitting to the next to it the juyce received from that immediately before it: so that it hath one constant course, from the root (which sucks it from the earth) to the top of the highest spring; in which if it should be intercepted and stopt by any maiming of the bark (the channel it ascends by), it would there break out and turn into drops, or gum, or some such other substance as the nature of the plant requires; and all that part of it to which none of this juyce can ascend would dry and wither and grow dead.

But Sensible living creatures we may fitly compare to the second machine of the Mint at *Segovia*. For in them, though every  
part



part and member be as it were a complete thing of it self; yet every one requires to be directed and put on in its motion by another: and they must all of them (though of very different natures and kinds of motion) conspire together, to effect any thing that may be for the use and service of the whole. And thus we find in them perfectly the nature of a mover and a moveable: each of them moving differently from one another, and framing to themselves their own motions in such sort as is most agreeable to their nature; when that part which sets them on work hath stir'd them up.

And now, because these parts (the movers and the moved) are parts of one whole; we call the entre thing *Automatum* or *se movens*, or a Living Creature. Which also may be fitly compared to a Joyner, or a Painter, or other craftsman; that had his tools so exactly fitted about him, as, when he had occasion to do any thing in his trade, his tool for that action were already in the fittest position for it to be made use of: so as, without removing himself from the place where he might sit invironed with his tools, he might, by only pulling of some little cords, either apply the matter to any remote tool, or any of his tools to the matter he would work upon; according as he findes the one or the other more convenient for performance of the actions he intends.

Wheras in the other, there is no variety of motions; but one and the same goes quite through the body, from one end of it to the other. and the passage of the moisture through it, from one part to another next (which is all the motion it hath), is, in a manner, but like the rising of water in a Stil; which by heat is made to creep up by the sides of the glass, and from thence runs through the nose of the Limbeck, and falls into the receiver. So that, if we will say that a Plant lives, or that the whole moves it self, and every part moves another; 'tis to be understood in a far more imperfect manner, then when we speak of an Animal; and the same words are attributed to both, in a kind of equivocal sense. But, by the way I must note, that under the title of Plants, I include not *Zoophytes* or Plant Animals; that is, such creatures as, though they go not from place to place, and so cause a local motion of their whole substance, yet in their parts they have a distinct and articulate motion.

But, to leave comparisons, and come to the proper nature of the things:



7:  
How plants  
are framed.

things. Let us frame a conception, that, not far under the *superficies* of the earth, there were gather'd together divers parts of little mixed bodies, which in the whole sum were yet but little: and that this little mass had some excess of fire in it; such as we see in wet Hay, or in muste of wine, or in woort of beer, and that withal, the drought of it were in so high a degree, as this heat should not find means (being too much compressed) to play his game: and that, lying there in the bosome of the earth, it should, after some little time, receive its expected and desired drink, through the benevolence of the heaven; by which it being moistned, and therby made more pliable and tender and easie to be wrought upon, the little parts of fire should break loose, and, finding this moisture a fit subject to work upon, should drive it into all the parts of the little mass, and digesting there should make the mass swel. Which action, taking up long time for its performance, in respect of the small increase of bulk made in the mass by the swelling of it, could not be hindred by the pressing of the earth, though lying never so weightily upon it: according to the maxime we have above deliver'd, that any little force, be it never so little, 'tis able to overcome any great resistance, be it never so powerful; if the force multiply the time it works in, sufficiently to equalize the proportions of the agent and the resistant.

This increase of bulk and swelling of the little mass will, of its own nature, be towards all sides, by reason of the fire & heat that occasions it (whose motion is on every side, from the centre to the circumference): but it will be most efficacious upwards, towards the air, because the resistance is least that way; both by reason of the little thickness of the earth over it, as also by reason that the uper part of the earth lies very loose and is exceeding porous, through the continual operation of the Sun, and falling of rain upon it. It cannot choose therefore but mount to the air; and the same cause that makes it do so presses, at the same time, the lower parts of the mass downwards. But, what ascends to the air must be of the hotter and more moist parts of the fermenting mass; and what goes downwards must be of his harder and drier parts, proportionate to the contrary motions of fire and earth, which predominate in these two kinds of parts. Now, this that is push'd upwards coming



coming above ground, and being there exposed to Sun and wind, contracts thereby a hard and rough skin on its outside; but within is more tender: in this sort it defends it self from outward injuries of weather, whiles it mounts; and by thrusting other parts down into the earth, it holds it self steadfast, that, although the wind may shake it, yet it cannot overthrow it. The greater this Plant grows, the more juice daily accreues to it, and the heat is encreased; and consequently, the greater abundance of humours is continually sent up. Which when it begins to clog at the top, new humours pressing upwards forces a breach in the skin: and so a new piece, like the main stem, is thrust out and begins on the sides; which we call a Branch. Thus is our Plant amplified; till nature, not being able still to breed such strong issues, falls to works of less labour, and pushes forth the most elaborate part of the plants juice into more tender substances; but especially, at the ends of the branches, where abundant humour, but at the first not well concocted, grows into the shape of a Button; and more and better concocted humour succeeding, it grows softer and softer (the Sun drawing the subtilest parts outwards), excepting what the coldness of the air and the roughness of the wind harden into an outward skin. So then, the next parts to the skin are tender; but the very middle of this button must be hard and dry, by reason that the Sun from without, and the natural heat within, drawing and driving out the moysture and extending it from the center, must needs leave the more earthy parts much shrunk up & hardned by their evaporating out from them: which hardning being an effect of fire within and without, that bakes this hard substance, incorporates much of it self with it as we have formerly declared in the making of salt by force of fire. This button, thus dilated and brought to this pass, we call the Fruit of the Plant: whose harder part encloses oftentimes another, not so hard as dry. The reason whereof is, because the outward hardness permits no moisture to soake, in any abundance, through it; and then, that which is enclosed in it must needs be much dried; though not so much, but that it still retains the common nature of the plant. This drought makes these inner parts to be like a kind of dust; or at least, such as



may be easily dried into dust, when they are bruised out of the husk that incloses them : And, in every parcel of this dust, the nature of the whole resides, as it were, contracted into a small quantity. For, the juice which was first in the button, and had passed from the root through the manifold varieties of the divers parts of the plant, and suffer'd much concoction, partly from the Sun, and partly from the inward heat imprison'd in that harder part of the fruit, is, by these passages strainings and concoctions, become at length to be like a tincture extracted out of the whole plant; and is at last dried up into a kind of magistery. This we call the *Seed*: which is of a fit nature, by being buried in the earth and dissolv'd with humour, to renew and reciprocate the operation we have thus described. And thus, you have the formation of a Plant.

8.  
How Sensitive  
Creatures are  
formed.

But a Sensitive Creature being compared to a Plant, as a plant is to mixed body ; you cannot but conceive that he must be compounded, as it were, of many plants; in like sort as a plant is of many mixed bodies. But so, that all the Plants, which concur to make one *Animal*, are of one kind of nature and cognation : and besides, the matter of which such diversity is to be made, must of necessity be more humid and figurable, then that of an ordinary plant ; and the Artificer which works and moulds it, must be more active. Wherefore, we must suppose that the mass, of which an *Animal* is to be made, must be actually liquid: and the fire that works upon it, must be so powerful, that, of its own nature, it may be able to convert this liquid matter into such breaths and steams, as we see use to rise from water, when the Sun or fire works upon it. Yet, if the mass were altogether as liquid as water, it would vanish away by heat boiling it, and be dried up ; therefore, it must be of such a convenient temper, that, although in some of its parts it be fluid and apt to run, yet by others it must be held together; as we see that unctuous things for the most part are; which will swell by heat, but not fly away.

So then, if we imagine a great heat to be imprison'd in such a liquor ; and that it seeks by boiling to break out, but that the solidness and viscosness of the substance will not permit it to evaporate: it cannot chuse but comport it self in some such sort as we see butter or oyl in a frying-pan over the fire, when it



it rises in bubbles; but much more efficaciously. For, their body is not strong enough to keep in the heat, and therefore those bubbles fall again; whereas, if it were, those bubbles would rise higher and higher, and stretch themselves longer and longer (as when the Soap-boylers boyl a strong unctuous lye into Soap), and every one of them would be as it were a little brook wherof the channel would be the enclosing substance, and the inward smoak that extends it might be compared to the water of it: as when a glass is blown out by fire and air into a long figure.

Now we may remember, how we have said, where we treated of the Production and Resolution of Mixed bodies, that there are two sorts of liquid substantial parts, which by the operation of fire are sent out of the body it works upon; the watery, and the oily parts. For, though there appear sometimes some very subtile and Ethereal parts of a third kind (which are the *Aque Ardentēs*, or burning spirits;) yet in such a close distilling or circulation as this is, they are not sever'd by themselves, but accompany the rest: and especially the watery parts, which are of a nature, that the rising Ethereal spirits easily mingle with, and extend themselves in it; whereby the water becomes more efficacious, and the spirit less fugitive.

Of these liquid parts which the fire sends away, the watry ones are the first, as being the easiest to be raised: the oily parts rise more difficultly, and therefore come last. And in the same manner it happens in this emission of brooks; the watry and oily steams will each of them fly into different reserves: and if there arrive to them abundance of their own quality, each of them must make a substance of its own nature; by settling in a convenient place, and by due concoction. Which substance after it is made and confirm'd, if more humidity and heat press it, will again break forth into other little channels. But, when the watry and oily parts are boyl'd away, there remain yet behind other more solid and fixed parts, and more strongly incorporated with fire than either of these: which yet cannot drie up into a fiery salt, because a continual accession of humour keeps them always flowing; and so they become like a cauldron of boiling ~~fire~~ <sup>fire</sup>. Which must propagate it self as wide as either of the other; since the

+ water



activity of it must needs be greater then theirs (as being the source of motion to them) and that there wants not humidity for it to extend it self by.

And thus you see three roots of three divers plants, all in the same plant, proceeding by natural resolution from one primitive source. Wherof that which is most watry is fittest to fabricate the body and common outside of the triformed plant: since, water is the most figurable principle in nature, and most susceptible of multiplication and by its cold is easiest to be hardened, and therefore fittest to resist the injuries of enemy-bodies that may infest it. The oily parts are fittest for the continuance and solidity of the plant: for, we see that viscuosity and oylineſs hold together the parts where they abound; and they are slowly wasted by fire, but conserve and are an aliment to the fire that consumes them. The parts of the third kind are fittest for the conservation of heat: which, though in them it be too violent, yet is necessary for working upon other parts, and maintaining a due temper in them.

And thus we have armed our plant with three sorts of rivers or brooks to run through him, with as many different streams: the one of a gentle balsamike oyle; another, of streaming fire; and the third, of a con-natural and cooler water to irrigate and temper him. The streams of water (as we have said) must run through the whole fabrick of this triformed plant: and because it is not a simple water, but warm in a good degree, and as it were a middle substance betwixt water and air (by reason of the ardent volatile spirit that is with it), 'tis of a fit nature to swell, as air doth; and yet withall to resist violence in a convenient degree, as water doth. Therefore, if from its source nature sends abundance into any one part, that part must swell and grow thicker and shorter; and so must be contracted that way which nature has order'd it. Whence we perceive a means, by which nature may draw any part of the outward fabrick which way soever she is pleased, by set instruments for such an effect. But, when there is no motion, or but little, in these pipes, the standing stream, that is in a very little, though long, channel, must needs be troubled in its whole body; if any one part of it be press'd upon, so as to receive thereby any impression: and therefore



fore whatever is done upon it, though at the very furthest end of it, makes a commotion and sends an impression up to its very source. Which appearing, by our former discourse, to be the origine of particular and occasional motions; 'tis obvious to conceive how it is apt to be moved and wrought by such an impression, to set on foot the beginning of any motion; which by nature's providence is convenient for the plant, when such an impression is made upon it.

And thus you see this plant hath the virtue both of sense or feeling; that is, of being moved and effected by extern objects, lightly striking upon it; as also of moving it self, to or from such an object; according as nature shall have ordain'd. Which in sum is, that This Plant is a Sensitive Creature, composed of three sources, the Heart, the Brain, and the Liver; whose off-springs are the Arteries, the Nerves, and the Veins: which are fill'd with Vital Spirits, with Animal Spirits, and with Bloud; and by these the Animal is heated, nourished, and made partaker of Sense and Motion.

Now, referring the Particular motions of Living Creatures to another time: we may observe, that both kinds of them, as well Vegetables as Animals, agree in the nature of sustaining themselves in the three common actions of generation, nutrition, and augmentation; which are the beginning, the progress, and the conserving of life. To which three we may add the (not so much action as) passion of Death; and of Sickness or decay, which is the way to death.

#### CHAP. XXIV.

*A more particular survey of the generation of Animals, in which is discover'd what part of the Animal is first generated.*

**T**O begin then with examining how Living Creatures are ingender'd: our main question shall be, Whether they be framed entirely at once; or successively, one part after another? And, if this latter way; which part first? Upon the discussion of which, all that concerns generation will be explicated; as much as concerns our purpose in hand. To deduce this from its origine, we may remember how our Masters tell us, that, when any living creature is past the heat of its augmentation or growing;

1.  
The opinion  
that the seed  
contains formally every  
part of the parent.



growing; the superfluous nourishment settles it self in some appointed place of the body, to serve for the production of some other. Now it is evident, that this superfluity comes from all parts of the body, and may be said to contain in it, after some sort, the perfection of the whole living creature. Be it how it will, 'tis manifest that the living creature is made of this superfluous moisture of the parent: which, according to the opinion of some, being compounded of several parts derived from the several limbs of the parent, those parts, when they come to be fermented in convenient heat and moisture, take their posture and situation, according to the posture and disposition of parts that the living creature had from whence they issued; and then they growing daily greater and solider (the effects of moisture and heat,) at length become such a creature as that was, from whence they had their origine:

Which an accident, that I remember, seems much to confirm. It was of a Cat, that had its tail cut off when it was very young: which Cat hapning afterwards to have young ones, half the kitlings proved without tails, and the other half had them in an ordinary manner; as if nature could supply but on one partners side, not on both. And another particular, that I saw when I was at *Argiers*, makes to this purpose: which was a woman that having two thumbs upon the left hand; four daughters that she had all resembled her in the same accident, and so did a little child, a girl of her eldest daughters; but none of her sons. Whiles I was there, I had a particular curiosity to see them all: and though it be not easily permitted to Christians, to speak familiarly with Mahometan women; yet the condition I was in there, and the civility of the *Basha*, gave me the opportunity of full view and discourse with them. And the old woman told me, that her mother and grandmother had been in the same manner. But, for them it rests upon her credit: the others I saw my self.

2.  
The former  
opinion re-  
jected.

But the opinion which these accidents seem to support, though at the first view it seems smoothly to satisfy our inquiry, and fairly to compass the making of a living creature; yet, looking further into it, we shall find it fall exceeding short of its promising, and meet with such difficulties, as it cannot overcome. For first, let us cast about how this compound of several parts, that  
serves



serves for the generation of a new living creature, can be gather'd from every part and member of the parent : so to carry with it in little the complete nature of it. The meaning hereof must be, that this superfluous aliment either passes through all and every little part and particle of the parents body; and in its passage receives something from them : or else, that it receives only from all similar and great parts.

The former seems impossible; for, how can one imagine that such juice should circulate the whole body of an Animal, and visit every atome of it, and retire to the reserve where it is kept for generation; and no part of it remain absolutely behind, sticking to the flesh or bones that it bedews, but that still some part returns back from every part of the Animal? Besides, consider those parts that are most remote from the channels which convey this juice how, when they are fuller of nourishment than they need, the juice which overflows from them comes to the next part and, settling there and serving it for its due nourishment, drives back into the channel that which was betwixt the channel and it self: so that here there is no return at all from some of the remote parts; and much of that juice which is rejected never went far from the channel it self. We may therefore safely conclude, that 'tis impossible every little part of the whole body should remit something impregnated and imbued with the nature of it.

But then you may peradventure say, that every similar part doth. If so, I would ask, how it is possible that, by fermentation only, every part should regularly go to a determinate place, to make that kind of Animal, in which every similar part is diffused to so great an extent? How should the nature of flesh here become broad there round, and take just the figure of the part it is to cover? How should a bone here be hollow, there be bony, and in another part take the form of a rib; and those many figures which we see of bones? And the like we might ask of every other similar part; as, of the veins, and the rest. Again, seeing it must of necessity happen, that at one time more is remitted from one part than from another; how comes it to pass that, in the collection, the due proportion of nature is so punctually observed? Shall we say that this is done by some cunning artificer, whose work it is to set all these parts in their due posture; which

*Aristotle*



*Aristotle* attributes to the seed of the male? But this is impossible: for, all this diversity of work is to be done at one time, and in the same occasions; which can no more be effected by one agent, then multiplicity can immediately proceed from unity.

But, besides that there can be no agent to dispose of the parts when they are gather'd; 'tis evident that a sensitive creature may be made, without any such gathering of parts beforehand from another of the same kind: for else, how could vermine breed out of living bodies or out of corruption? How could Rats come to fill ships; into which never any were brought? How could Frogs be ingendred in the air? Eels, of dewy turfs, or of mud? Toads, of Ducks? Fishs of Herns? and the like. To the same purpose, when one *species* or kind of Animal is changed into another; as when a Caterpillar or a Silk-worm becomes a Flie, 'tis manifest, there can be no such precedent collection of parts.

3.  
The Authours  
opinion of  
this question.

And therefore, there is no remedy but we must seek out some other means and course of generation, then this. To which we may be lead, by considering how a Living Creature is nourish'd and augmented: for why should not the parts be made in Generation, of a matter lik that which makes them in Nutrition? If they be augmented by one kind of juyce that, after several changes, turns at length into flesh and bone, and every sort of mixed body or similiar part, wherof the sensitive creature is compounded; and that joyns it self to what it finds already made: why should not the same juyce, with the same progress of heat and moysture and other due temperaments, be converted at first into flesh and bone; though none be formerly there to joyn it self to?

Let us then conclude that the juyce, which serves for nourishment of the Animal, being more then is requisite for that service; the superfluous part of it is drain'd from the rest, and reserv'd in a place fit for it: where by little and little, through digestion, it gains strength and vigour and spirits to it self, and becomes an homogeneous body (such as other simple compounds are); which, by other degrees of heat & moisture, is chang'd into another kind of substance, & that again by other temperaments, into an other. And thus, by the course of nature, and by passing successively many degrees of temper, and by receiving a total change



change in every one of them ; at length an Animal is made, of such juice as afterwards serves to nourish him.

But, to bring this to pass a shorter way, and with greater facility, some have been of opinion, that all similar things, of whatever substance, are undiscernably mixed in every thing that is : and that, to the making of any body, out of any thing, there is no more required, but to gather together those parts which are of that kind ; and to separate, and cast away from them, all those which are of a nature differing from them.

4.  
Their opinion  
refuted, who  
hold that eve-  
ry thing con-  
tains formally  
all things.

But, this speculation will appear a very airy and needless one, we consider into how many several substances the same *species* of a thing may be immediately changed ; or rather, how many several substances may be encreas'd immediately from several equal individuals of the same thing : and then take an account, how much of each individual is gone into each substance which it hath so increas'd, For, if we sum up the quantities that, in the several substances, are thereby encreas'd ; we shall find they very much exceed the whole quantity of any one of the individuals : which should not be, if the supposition were true ; for, every individual should be but one one total, made up of the several different similar parts, which encrease the several substances, that extract out of them what is of their own nature.

This will be better understood by an example. Suppose that a Man, a Horse, a Cow, a Sheep, and 500 more several *species* of living creatures should make a meal of Letuces. To avoid all perplexity in conceiving the argument, let us allow that every one did eat a pound : and let us conceive another pound of this herb to be burned ; as much to be putrified under a Cabage root, and the like under 500 plants more of divers *species*. Then cast how much of every pound of lettuce is turned into the substances that are made of them, or encreas'd by them ; as, how much as the one pound hath made, how much water hath been distil'd out of another pound ; how much a man hath been encreas'd by a third ; how much a horse by a fourth, how much earth by the putrefaction of a fifth pound, how much a Cabage hath been encreas'd by a sixth : and so go over all the pounds that have been turned into substances of different *species* ( which may be multiplied as much as you please. ) And when you have sum'd up  
all



all these several quantities, you find them far to exceed the quantity of one pound: which it would not do, if every pound of Letuce were made up of several different similiar parts actually in it, that are extracted by different substances of the natures of those parts; and that no substance could be encreas'd by it, unless parts of its nature were originally in the letuce.

5.  
The Authors  
opinion con-  
cerning the  
generation of  
Animals de-  
clared and  
confirm'd.

On the other side, if we but cast our eye back upon the principles we have laid, where we discourse of the composition of bodies; we shall discern how this work of changing one thing into another, either in nutrition, in augmentation, or in generation, will appear not only possible, but easie to be effected. For, out of them 'tis made evident, how the several varieties of solid and liquid bodies, all differences of natural qualities, all consistences, and whatever else belongs to similar bodies, results out of the pure and single mixture of rarity and density: so that, to make all such varieties as are necessary, there's no need of mingling or separating any other kinds of parts; but only an art or power to mingle, in due manner, plain rare and dense bodies one with another. Which very action, and none other, (but with excellent method and order, such as becomes the great Architect that hath design'd it) is perform'd in the generation of a living creature; which is made of a substance at first far unlike what it afterwards grows to be.

If we look upon this change in gross, and consider but the two extremes; to wit, the first substance of which a living creature made, and it self in its full perfection: I confess, it may well seem incredible, how so excellent a creature can derive its origine from so mean a principle, and so far remote and differing from what it grows to be. But, if we examine it in retail, and go along anatomizing it in every step and degree that it changes by: we shall find that every immediate change is so near, and so palpably to be made by the concurrent causes of the matter prepared; as we must conclude, it cannot possibly become any other thing then just what it doth become.

Take a Bean, or any other seed; and put it into the earth, and let water fall upon it: can it be but the bean must swell? The bean swelling, can it chuse but break the skin? The skin broken, can it chuse (by reason of the heat that is in it)

but



but push out more matter, and do that action which we may call germinating? Can these germs chuse but pierce the earth in small strings, as they are able to make their way? Can these strings chuse but be harden'd, by the compression of the earth, and by their own nature; they being the heaviest parts of the fermented bean? And can all this be any thing else but a root? Afterwards, the heat that is in the root mingling it self with more moisture, and according to its nature, springing upwards; will it not follow necessarily, that a tender green substance (which we call a bud, or leaf must appear a little above the earth: since tenderness, greenness, and ascent, are the effects of those two principles, heat & moisture? And, must not this green substance change from what it was at first, by the Sun and Air working upon it, as it grows higher; till at length it hardens into a stalk? All this while, the heat in the root sublimes up more moisture; which makes the stalk at first grow rank, and encrease in length. But, when the more volatile part of that warm juice is sufficiently depured and sublimed; will it not attempt to thrust it self out beyond the stalk, with much vigour and smartness? And, as soon as it meets with the cold air in its eruption, will it not be stop'd and thick'ned? And, new parts flocking still from the root; must they not clog that issue, and grow into a button, which will be a bud? This bud being hard'ned at the sides, by the same causes which hard'ned the stalk, and all the while the inward heat still streaming up, & not enduring to be long enclosed, especially when, by its being stop'd, it multiplies it self), will it not follow necessarily, that the tender bud must cleave and give way to that spiritual juice; which, being purer then the rest (through its great sublimation), shews it self in a purer and nobler substance than any that is yet made, and so becomes a flower? From hence, if we proceed as we have begun and weigh all circumstances, we shall see evidently, that another substance must needs succeed the flower; which must be hollow and contain a fruit in it: and that this fruit must grow bigger and harder. And so, to the last period of the generation of new beans.

Thus, by drawing the thrid carefully along through your fingers, and staying at every knot to examine how it is tyed; you see, that this difficult progress of the generation of living creatures,



creatures is obvious enough to be comprehended: and that the steps of it are possible to be set down; if one would but take the pains and afford the time that is necessary (less then that Philosopher, who for so many years gave himself wholly up to the single observing of the nature of Bees) to note diligently all the circumstances in every change of it. In every one of which the thing that was becoms absolutely a new thing; and is endew'd with new properties and qualities, different from those it had before; as Physicians, from their certain experience, assure us. And yet every change is such, as, in the ordinary and general course of nature, (wherin nothing is to be consider'd, but the necessary effects following out such Agents working upon such patients, in such circumstances) 'tis impossible that any other thing should be made of the precedent, but that which is immediately subsequent to it.

Now, if all this orderly succession of mutations be necessarily made in a Bean, by force of sundry circumstances and external accidents: why may it not be conceiv'd, that the like is also done in sensible creatures; but, in a more perfect manner, they being perfecter substances? Surely the progress we have set down is much more reasonable, then to conceive that, in the meal of the Bean, are contain'd, in little, several similar substances; as, of a root, of a leaf, a stalk, a flower, a cod, fruit, and the rest: and that every one of these, being from the first still the same that they shall be afterwards, do but suck in more moisture from the earth, to swell and enlarge themselves in quantity. Or that, in the seed of the male, there is already in act the substance of flesh, of bone, of sinews, of veins, & the rest of those several similar parts, which are found in the body of an Animal; and that they are but extended to their due magnitude, by the humidity drawn from the mother; without receiving any substantial mutation, from what they were originally in the seed.

Let us then confidently conclude, that all generation is made of a fitting, but remote, homogenial compounded substance; upon which outward Agents working, in the due course of nature change it into another substance, quite different from the first, and make it less homogenial then the first was. And other circumstances and agents change this second into a third; that third into a fourth; and so onwards, by successive mutations,  
(that



that still make every new thing become less homogeneous than the former was, according to the nature of heat mingling more and more different bodies together ) till that substance be produced, which we consider in the period of all these mutations.

And this is evident out of many experiences. As for example, in Trees, the bark, which is opposed to the North wind, is harder & thicker than the contrary side which is opposed to the South; and a great difference will appear in the grain of the wood; even so much, that skilful people will, by feeling and seeing a round piece of the wood after the Tree is fell'd, tell you in what situation it grew, and which way each side of that piece look'd. And *Josephus Acosta* writes of a Tree in *America*, that, on the one side being situated towards great hills, and on the other exposed to the hot Sun; the one half of it flourishes at one time of the year, and the other half at the opposite season: and some such like may be the cause of the strange effects we sometimes see of trees, flourishing or bearing leaves at an unseasonable time of the year; as in particular, in the famous Oak in the *New Forrest*, and in some others in our Island: in which peradventure the Soil they grow in may do the same effect, as the winds and Sun did in the Tree that *Acosta* mentions. For, we daily see, how some soiles are so powerful over some kind of corn, that they will change the very nature of it; so that, you shall reap Oats or Rye, after you have sown Wheat there.

Which shews evidently that, since the outward circumstances can make the parts or the whole of any substance become different from what they were at first; generation is not made by aggregation of like parts to presupposed like ones, nor by a specifical worker within; but, by the compounding of a seminal matter with the juice which accrues to it from without, and with the streams of circumstant bodies; which, by an ordinary course of nature, are regularly imbibed in it by degrees, and at every degree change it into a different thing, such as is capable to result out of the present compound, (as we have said before) till it arrive to its full perfection.

Which yet is not the utmost period of nature's changes; for,  
S from



That one substance is changed into another.

from that, (for example, from corn or an Animal) it carries it on, still changing it, to be meal or a *Cadaver*, from thence, to be bread or dirt, after that, to be blood or grass. And so, still turning about her wheel (which suffers nothing to remain long in the state it is in), she changes all substances from one into another: And, by reiterated revolutions, makes in time every thing of every thing. As when of mud she makes Tadpoles, and Frogs of them, and afterwards mud again of the Frog: or when she runs a like progress, from Earth to Worms, and from them to Flies, and the like; so changing one Animal into such another, as, in the next precedent step, the matter in those circumstances is capable of being changed into; or rather (to say better) must necessarily be changed into.

To confirm this by experience. I have been assured, by one who was very exact in noting such things, that he once observ'd in *Spain*, in the Spring season, how a stick, lying in a moist place, grew, in tract of time, to be most of it a rotten dirty matter; and that, at the dirty end of the stick, there began a rude head to be form'd of it by little and little; and, after a while, some little legs began to discover themselves near this unpolish'd head, which daily grew more and more distinctly shaped. And then, for a pretty while (for it was in a place where he had the conveniency to observe daily the progress of it, and no body came near to stir it in the whole course of it) he could discern where it ceas'd to be a body of a living creature, and where it began to be dead stick or dirt; all in one continue quantity or body. But, every day the body grew longer and longer, and more legs appear'd; till at length, when he saw the Animal almost finish'd, and near separating it self from the rest of the stick; he stay'd then by it, and saw it creep away in a Caterpillar, leaving the stick and dirt, as much wanting of its first length, as the worms body took up. Peradventure, the greatest part of such creatures makes their way by such steps into the world. But, to be able to observe their progress thus distinctly, as this Gentleman did, happens not frequently.

7.  
Concerning  
the hatching of

Therefore, to satisfy our selves herein, it were well (we made our remarks in some creatures, that might be continually in our power



Chickens, and  
the generation  
of the other  
Animals.

power to observe in them the course of nature, every day and hour. Sir *John Heydon*, the Lieutenant of his Majesties Ordnance (that generous and knowing Gentleman, and consummate Souldier both in Theory and Practice) was the first that instructed me how to do this; by means of a furnace, so made as to imitate the warmth of a sitting Hen. In which you may lay several eggs to hatch; and by breaking them at several ages, you may distinctly observe every hourly mutation in them, if you please. The first will be, that on one side you shall find a great resplendent clearness in the white. After a while, a little spot of red matter, like blood, will appear in the midst of that clearness, fast'ned to the yolk: which will have a motion of opening and shutting; so as sometimes you will see it, and straight again it will vanish from your sight, and indeed, at first it is so little, that you cannot see it, but by the motion of it: for, at every pulse, as it opens you may see it, and immediately again it shuts in such sort, as it is not to be discerned. From this red speck, after a while, there will stream out a number of little (almost imperceptible) red veins. At the end of some of which, in time, there will be gathered together a knot of matter, which by little and little will take the form of a head; and you will ere long begin to discern eyes and a beak in it. All this while the first red spot of blood grows bigger and solider: till at length it becomes a fleshy substance, and, by its figure may easily be discern'd to be the heart; which as yet hath no other inclosure but the substance of the egg. But, by little and little, the rest of the body of an Animal is framed, out of those red veins which stream out all about from the heart. And in process of time, that body encloses the heart within it by the chest; which grows over on both sides, and in the end meets, and closes it self fast together. After which this little creature soon fills the shell, by converting into several parts of it self all the substance of the egg. And then growing weary of so straight a habitation, it breaks prison, and comes out a perfectly formed Chicken.

In like manner, in other creatures (which in latine are call'd *Vivipera*, because their young ones are quick in their mothers Womb) we have, by the relation of that learned and ex-



aſt ſearcher into nature, *Dr. Harvey*; that the ſeed of the male, after his accoupling with the female, doth not remain in her womb, in any ſenſible bulk: but (as it ſeems) evaporates and incorporates it ſelf, either into the body of the Womb, or rather into ſome more interior part; as, into the ſeminary veſſels. Which, being a ſolid ſubſtance, much reſembling the nature of the Females ſeed, is likely to ſuck up, by the mediation of the Females ſeed, the Male ſeed incorporated with it and, by incorporation, turn'd as it were into a vapour: in ſuch ſort as we have formerly explicated, how the body of a Scorpion or Viper draws the poyſon out of the wound. And after a certain time (*Dr. Harvey* noted the ſpace of ſix weeks or two moneths in Does or Hindes) theſe ſeeds diſtill again into the Womb; and by little and little clarifie in the miſt, and a little red ſpeck appears in the cencer of the bright clearneſs; as we ſaid before of the egg.

8.  
From whence  
it happens,  
that the defi-  
ciencies or ex-  
creſcences of  
the parents  
body are often  
ſeen in their  
children.

But we ſhould be too blame to leave our Reader without clearing that difficulty, which cannot chuſe but have ſprung up in his thoughts; by occaſion of the relations we made, at the entrance into this point, concerning the Cat whoſe kitlings were half with tails and half without: and the womans daughters at *Argiers*, that had, as well as their mother, excreſcences upon their left thumbs, imitating another leſſer thumb; and the like effects whenever they happen, which they do frequently enough.

Let him therefore remember, how we have determin'd that generation is made of the blood: which, being diſperſed into all the parts of the body, to irrigate every one of them, and convey fitting ſpirits into them from their ſource or ſhop where they are forged; ſo much of it as is ſuperabundant to the nourishing of thoſe parts is ſent back again to the heart, to recover the warmth and ſpirits it hath loſt by ſo long a journey. By which perpetual courſe of a continued circulation, 'tis evident that the blood, in running thus through all the parts of the body, muſt needs receive ſome particular concoction or impreſſion from every one of them. And by conſequence, if there be any ſpecificall vertue in one part, which is not in another; then the blood, returning  
from



from thence, must be endued with the vertue of that part. And the purest part of this bloud, being extracted like a quintessence out of the whole mass, is refer'd in convenient receptacles or vessels, till there be use of it, and is the matter or seed, of which a new Animal is to be made: in whom will appear the effect of all the specifical virtues drawn by the bloud in its iterated courses, by its circular motion through all the several parts of the parents body.

Whence it follows, that, if any part be wanting in the body wherof this seed is made, or be superabundant in it; whose virtue is not in the rest of the body: the vertue of that part cannot be in the bloud, or will be too strong in the bloud, and by consequence, it cannot be at all, or it will be too much, in the seed. And, the effect proceeding from the seed, that is, the young Animal, will come into the world favouring of that origine; unless the Mother's seed supply or temper what the Father's was defective or superabundant in, or contrariwise the Father's correct the errors of the Mother's.

But peradventure, the Reader will tell us, that such a specifical virtue cannot be gotten by concoction of the blood, or by any pretended impression in it; unless some little particles of the nourished part remain in the blood, and return back with it, according to that maxim of Geber, *Quod non ingreditur non immutat*, no body can change another unless it enter into it, and, mixing it self with it, become one with it. And that so in effect, by this explication, we fall back into the opinion which we rejected.

To this I answer, that the difference is very great between that opinion and ours; as will appear evidently, if you observe the two following assertions of theirs. First they affirm; that a living creature is made meerly by the assembling together of similar parts, which were hidden in those bodies from whence they are extracted in generation: whereas we say that bloud, coming to a part to irrigate it, is, by its passage through it and some little stay in it, and by its frequent returns thither, at length transmuted into the nature of that part; and thereby the specifical virtues of every part grow greater, and are more diffused and extended.

The difference  
between the  
Authors opi-  
nion, and the  
former one.



Secondly, they say, that the *Embryon* is actually formed in the seed; though in such little parts as it cannot be discerned, till each part have enlarged and increased it self, by drawing to it from the circumstant bodies more substance of their own nature. But we say, that there is one Homogenal substance made of the blood, which hath been in all parts of the body; and this is the seed: which contains not in it any figure of the Animal from which it is refined, or of the Animal into which it hath a capacity to be turned (by the addition of other substances); though it have in it the vertues of all the parts it hath often run through.

By which term of *specifike vertues*, I hope, we have said enough in sundry places of this discourse, to keep men from conceiving that we mean any such inconceivable quality, as modern Philosophers too frequently talk of; when they know not what they say or think, nor can give any account of. But that it is such degrees and numbers of rare and dense parts mingled together, as constitute a mixed body of such a temper and nature: which degrees and proportions of rare and dense parts, and their mixture together, and incorporating into one Homogenal substance, is the effect resulting from the operations of the exteriour agent, that cuts, imbibes, kneads, and boyls it to such a temper. Which exteriour agent, in this case, is each severall part of the Animals body, that this juice or blood runs through; and that hath a particular temper belonging to it, resulting out of such a proportion of rare and dense parts, as we have even now spoken of; and can no more be withheld from communicating its temper to the blood, that first soaks into it and soon after drains away again from it (according as other succeeding parts of blood drive it on): then a mineral channel can chuse but communicate its vertue to a stream of water that runs through it, and is continually grating off some of the substance of the Mineral earth, and dissolving it into it self.

10  
That the heart  
is imbued with  
the general  
specifike ver-  
tues of the

But, to go on with our intended discourse. The seed, thus imbued with the specifical vertues of all the severall parts of the parents body, meeting in a fit receptacle the other parents seed, and being there duly concocted, becomes first a heart. Which heart



heart, in this tender beginning of a new Animal, contains the several virtues of all the parts, that afterwards will grow out of it and be in the future Animal: in the same manner as the heart of a complete Animal: contains in it the specificke virtues of all the several parts of its own body, by reason of the bloods continual resorting to it in a circle from all parts of its body, and its being nourished by that juice, to supply the continual consumption which the extreme heat of it must needs continually occasion in its own substance; wherby the heart becoms in a manner the *Compendium* or abridgment of the whole Animal.

whole body:  
wherby is  
confirm'd the  
doctrine of the  
two former  
Paragraphes.

Now, this heart, in the growing *Embryon*, being of the nature of fire; as, on the one side, it streams out its hot parts; so, on the other, it sucks oyl or fewel to nourish it self out of the adjacent moist parts: which matter aggregated to it being sent abroad, together with the other hot parts that steam from it; both of them together stay and settle, as soon as they are out of the reach of that violent heat, that would not permit them to thicken or rest. And there they grow into such a substance, as is capable to be made of such a mixture; and are linked to the heart by some of those strings that steam out from it (for those steams likewise harden, as we shew'd more particularly, when we discours'd of the tender stalks of plants): and in a word, this becoms some other part of the Animal. Which thus encreases by order, one part being made after another; till the whole living creature be completely framed.

So that now you see, how mainly their opinion differs from ours: since, they say that there is actually in the seed a complete living creature; for, what else is a living creature, but bones in such parts, nerves in such others, blood and humours contain'd in such and such places, all as in a living creature? All which they say. But, we make the seed to be nothing else but one mixed body, of one homogeneal nature throughout; consisting of such a multiplicity of rare and dense parts, so ballanced and proportioned in number and magnitude of those parts, which are evenly shuffled and alike mingled in every little parcel of the whole substance: in such sort, that the operation



of nature upon this seed, may, in a long time and with a due process, bring out such figures, situation, and qualities (as fluidity, consistence, dryness, and the like), which, by much mixture and consequent alteration, may in the end become such as constitute a living creature of such a kind. And thus it appears that, although other substances and liquors and steams are, from time to time, mingled with the seed, and then with the heart, and afterwards with the other parts, as they grow on and increase; yet the main virtue of the ensuing Animal is first in the seed, and afterwards in the heart.

Whence the reason is evident, why both defects and excrescences pass sometimes from the parents to the children; to wit, when nothing supplies the defect or corrects the exorbitancy. Rather, after this which we have said, the difficulty will appear greater, in that such accidents are not always hereditary from the parents; but happen only now and then, some rare times. But, the same grounds we have laid will likewise solve this objection. For, seeing that the heart of the Animal, from whence the seed receives its proper nature (as we have declared) is impregnated with the specifick virtue of each several part of the body; it cannot be doubted but that the heart will supply for any defect hapned in another part, after it hath been imbued with that virtue, and is grown to a firmness and vigorous consistence, with that virtue moulded and deeply imbibed into the very substance of it. And although the heart should be tainted, from its first origine, with an undue virtue from some part (as it seems to have been in the mother of those daughters that had two thumbs upon one hand); yet it is not necessary that all the off-spring of that parent should be formed after that model; for, the other partners seed may be more efficacious and predominant in the geniture, over the faulty seed of the other parent; and then it will supply for and correct the others deviation from the general rule of nature. Which seems to be the cause of that womans male children; for, in them the fathers seed being strongest, all their fingers imitated the regularity of their Fathers: whereas the daughters (whose sex implies that the fathers seed was less active) carried upon some of theirs the resemblance of their mothers irregularity.

And



And, in confirmation of this doctrine, we daily see, that the Children of Parents who have any of their noble parts much and long distempred, wherby there must be a great distemper in the blood (which is made and concocted by their assistance), seldom fail of having strong inclinations to the distempers and diseases that either of their parents were violently subject to. Scarce any Father or Mother dyes of the Consumption of the Lungs, but their children inherit that disease in some measure: the like is of the Stone; the like of the Gout, the like of diseases of the brain, and of sundry others; when they infested the parents with any notable eminency. For the blood, coming continually to the heart from such ill-affected parts, by its circulation through the whole body, must needs in process of time alter and change the temper of the heart; and then both the heart gives a tainted impression to the blood that must be boyl'd into seed, and the parts themselves communicate their debilities and distempers to it: so that it is no wonder, if the seed partake of such depraved qualities; since it is a maxime among Physicians, that subsequent concoctions can never amend or repair the faults of the precedent ones.

Having waded thus far into this matter, and all experience agreeing that the whole Animal is not formed at once; I conceive there can be no great difficulty in determining what part of it is first generated: which we have already said to be the heart but peradventure the Reader may expect some more particular and immediate proof of it. 'Tis evident, that all the motions and changes we have observ'd in the Egg and in the *Doe* proceed from heat: and tis as certain, that heat is greatest in the centre of it; from whence it disperses it self to less and less. It must then necessarily follow, that the part in which heat most abounds, and which is the interior fountain of it from whence (as from a stock of their own) all the other parts derive theirs, must be formed first; and the others successively after it: according as they partake more or less of this heat; which is the Architect that moulds and frames them all. Undoubtedly this can be none other but the heart: whose motion and manner of working evidently appears in the twinckling of the first red spot (which is the first change) in the Egg, and in the

II  
That the heart  
is the first  
part genera-  
ted in a living  
creatures.

first



first matter of other living creatures: Yet I do not intend to say, that the heart is perfectly framed, and compleatly made up, with all its parts and instruments; before any other part be begun to be made: but only the most vertuous part; and, as it were, the marrow of it, which serves as a shop or hot forge to mold spirits in; from whence they are dispers'd abroad to form and nourish other parts that stand in need of them to that effect.

The shootings or little red strings that stream out from it must surely be arteries: through which the blood issuing from the heart, and there made and imbued with the nature of the seed, runs; till encountering with fit matter, it engrosses it self into brain, liver, lights, &c. From the brain chiefly grows the marrow and, by consequent, the bones containing it, (which seem to be originally but the outward part of the marrow, baked and hardned into a strong crust by the great heat that is kept in): as also the sinews, which are the next principal bodies, of strength, after the bones. The marrow being very hot dries the bones; and yet with its actual moisture it humects and nourishes them too, in some sort. The spirits that are sent from the brain do the like to the sinews. And lastly, the arteries and veins, by their blood, cherish and bedew the flesh. And thus the whole living creature is begun, framed and made up.

## C H A P. XXV.

*How a Plant or Animal comes to that figure it hath.*

I.  
That the figure of an *Animal* is produced by ordinary second causes, as well as any other corporeal effect.

**B**Ut, before we go any further, and search into the operations of this *Animal*, a wonderful effect calls our consideration to it: which is, how a Plant or Animal comes by the figure it hath, both in the whole and in every part of it? *Aristotle*, after he had beaten his thoughts as far as he could upon this question, pronounced that this effect could not possibly be wrought by the virtue of the first qualities; but that it sprung from a more divine origine: And most of the contemplators of Nature, since him, seem to agree, that no cause can be render'd of it; but that it is to be refer'd merely to the specifical nature



nature of the thing. Neither do we intend to derogate from either of these causes: since, both Divine Providence is eminently shown, in contriving all circumstances necessary for this work; and likewise, the first temperament that is in the seed must needs be the principal immediate cause of this admirable effect.

This latter then being supposed; our labour and endeavour will be to unfold (as far as so weak and dim eyes can reach) the excellency and exactness of Gods Providence; which cannot be enough adored, when it is reflected on and mark'd in the apt laying of adequate causes to produce such a figure, out of such a mixture first laid. From them, so artificially ranged, we shall see this miracle of nature to proceed; and not from an immediate working of God or nature, without convenient and ordinary instruments to mediate and effect this configuration, through the force and virtue of their own particular natures. Such a necessity to interest the chief workman at every turn, in particular effects, would argue him of want of skill and providence, in the first laying of the foundations of his designed Machine. He were an improvident Clockmaker, that should have cast his work so, as, when it were wound up and going, it would require the Masters hand at every hour, to make the Hammer strike upon the Bell. Let us not then, too familiarly and irreverently, ingage the Almighty Architect's immediate handy-work in every particular effect of nature; *Tali non est dignus vindice nodus.*

But, let us take principles within our own kenning; and consider, how a body hath, of its own nature, three dimensions, (as Mathematicians use to demonstrate): and that the variety we see of figures in bodies proceeds out of the defect of some of these dimensions, in proportion to the rest. As for example, that a thing be in the form of a Square Tablet; is, for that the cause, which gave it length and breadth, could not also give it thickness in the same proportion: for, had it been able to give profundity as well as the other two, it had made a Cube instead of a Tablet. In like manner, the form of a lamina, or very long square, is occasion'd by some accident which hinders the cause from giving breadth and thickness proportiona-

2.  
That the several figures of bodies proceed from a defect in one of three dimensions; caused by the circumference of accidental causes.



tionable to the length. And so, other figures are made, by reason that their causes are some ways bound to give more of some dimension to one part then another.

As for example, when water falls out of the skie, it hath all the little corners or extancies of its body grated off by the air, as it rolls and tumbles down in it; so that it becomes round: and continues in that form, till, settling on some flat body (as Grass or a Leaf), it receives a little plainness, to the proportion of his weight mastering the continuity of it. And therefore, if the drop be great upon that plain body, it seems to be half a Sphere, or some less portion of one: but, if it be a little drop, then the flat part of it (which is that next the grass) is very little and undiscernable, because it hath not weight enough to press it much and spread it broad upon the grass, and so the whole seems in a manner to be a Sphere. But, if the extern causes had press'd upon this drop only broadways and thick ways (as when a Turner makes a round Pillar, of a square one) then it would have proved a *Cylinder*; nothing working upon it to grate off any of its length, but only the corners of the breadth and thickness of it.

And thus you see, how the fundamental figures (upon which all the rest are grounded) are contrived by nature: not by the work of any particular Agent that immediately Imprints a determinate figure into a particular body, as though it wrought it there at once, according to a foreconceiv'd design or intelligent aim of producing such a figure in such a body; but by the concurrence of several accidental causes, that all joyn in bringing the body, they file and work upon into such a shape.

Only, we had like to have forgotten the reason and cause of the concave figure in some parts of Plants: which, in the ordinary course of nature, we shall find to grow from hence, That a round outside being filled with some liquor, which makes it grow higher and higher, it happens that the succeeding causes contract this liquor and harden the outside; and then of necessity there must be a hollow *Cylinder* remaining, in lieu of the juice which before fill'd it. As we see every day in corn,  
and



and in Reeds, and in Canes, and in the stalks of many herbs : which, whilst they are tender and in their first growth, are full of juice ; and become afterwards hallow and dry.

But, because this discourse may peradventure seem too much in common : it will not be amiss to apply it to some particulars that seem very strange. And first, let us examine how the rocking of concrete juices ( which seems to be such an admirable mystery of Nature ) is performed. Allom falls down in lumps, Saltpeter in long icicles, and common Salt in squares : and this, not once or sometimes, now or then, but always constantly in the same order.

3.  
The former doctrine is confirmed by several instances.

The reason of these effects will easily be deduced out of what we have said. For, if all three be dissolv'd in the same water, Allom, being the grossest, falls first, and fastest, and, being of an unctious nature, the first part which falls doth not harden till the second comes to it; wherby this second sticks to the first and crushes it down, and this is serv'd in the same manner by the third : and so it goes on, one part squeezing another, till what is undermost grow hard enough to resist the weight of new falling parts ; or rather, till no more fall, but the liquor they were dissolv'd in is deliver'd of them all, and then they harden in that figure they were compress'd into.

As for Salt, which descends in the second place ; that swims first upon the water, and there gets its figure, which must be equally long and broad, because the water is indifferent to those two positions : but its thickness is not equal to its other two dimensions, by reason that, before it can attain to that thickness, it grows too heavy to swim any longer, and, after it is encreas'd to a certain bulk, the weight of it carries it down to the bottom of the water, and consequently it can encrease no more ; for, it encreases by the joyning of little parts to it, as it swims on the top of the water.

The Saltpeter falls last ; which being more difficult to be figured then the other two, because it is more dry then either of them, (as consisting chiefly of earthy and of fiery parts), is not equally encreased, neither in all three, nor in two dimensions, but hath its length exceeding both its breadth and thickness :  
and



and its lightness makes it fall last, because it requires least water to sustain it.

To give the causes of the figures of divers mixts, and particularly of some precious stones (which seems to be cast by Nature in exactest moulds), would oblige us to enter into the particular manner of their generation: which were exceeding hard, if not impossible, for us to do, by reason that Authors have not left us the circumstances, upon which we might ground our judgment concerning them, so particularly described as were necessary; nor our selves have met with the commodity of making such experiences, and of searching so into their beds as were requisite, to determine solidly the reasons of them. And indeed, I conceive, that oftentimes the relations which others have recorded of their generation would rather mislead then assist us: since it is very familiar in many men, to magnifie the exactness of Nature, in framing effects by phansie to themselves; when, to make their Wonder appear more just, they will not fail to set off their story with all advantageous circumstances, and help out what wants a little or comes but near the mark.

4.  
The same doctrine applied  
to plants.

But, to come closer to our purpose; that is, to the figures of living things. We see that the roots in the earth are all of them figured almost in the same fashion: for the heat residing in the midd<sup>l</sup>st of them pushes every way, and therupon, some of them become round, but others more long then round; according to the temper of the ground, or the season of the year, or the weather that happens: and this, not onely in divers kinds of Roots, but even in several of the same kind. That part of the plant which mounts upwards, for the most part, round and long; the cause wherof is evident. For, the juice which is in the middle of it working upwards (because the hardness of the bark will not let it out at the sides), and coming in more and more abundance (for the reasons we have above deliver'd), encreases that part equally every way but upwards; and therefore it must be equally thick and broad, and consequently round: but the length will exceed either of the other dimensions; because the juice is driven up with a greater force, and in more quantity then it is to the sides. Yet  
the



the broadness and thickness are not so exactly uniform, but that they exceed a little more at the bottom then at the top, which is occasion'd, partly by the contracting of juice into a narrower circuit, the further it is from the source; and partly by reason of the Branches, which, shooting forth, convey away a great part of the Juice from the main stock.

Now, if we consider the matter well, we shall find, that what is done in the whole tree, the very same is likewise done in every little leaf of it. For, a leaf consists of little branches shooting out from one greater branch, which is in the middle; and again, other less branches are derived from those second branches: and so still lesser and lesser, till they weave themselves into a close work, as thick as that which we see women use to fill up with Silk or Crewel, when in Tentwork they embroyder leaves or flowers upon Canvas. And this again is cover'd and, as it were, glew'd over, by the humour which, sticking to these little thrids, stops up every little vacuity, and by the air is hardened into such a skin as we see a leaf consists of.

4.  
The same doctrine declar'd in leaves of trees.

And thus it appears, how an account may be given of the figure of the leaves, as well as of the figure of the main body of the whole tree: the little branches of the leaf being proportionate in figure to the branches of the tree itself (so that each leaf seems to be the Tree in little), and the figure of the leaf depending of the course of these little branches; so that, if the greatest branch of the Tree be much longer then the others, the leaf will be a long one, but if the lesser branches spread broadways, the leaf will likewise be a broad one; so far, as even to be notch'd at the outsides, round about it, in great or little notches; according to the proportion of the Trees Branches. These Leaves, when they first break out, are foulded inwards; in such sort as the smalness and roundness of the passage in the wood, through which they issue, constrains them to be: where nevertheless the driness of their parts keep them asunder, as that one leaf doth not incorporate it self with another. But, so soon as they feel the heat of the Sun (after they are broken out into liberty), their tender branches by little and little grow



grow more straight : the concave parts of them drawing more towards the Sun, because he extracts and sucks their moisture from their hinder parts into their former, that are more exposed to his beams ; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which, if it be in excess, makes the leaf become crooked the contrary way ; as we see in divers flowers, and in sundry leaves during the Summers heat : witness, the Ivie, Roses full blown. Tulips, and all flowers in form of Bells ; and indeed all kinds of flowers whatever, when the Sun hath wrought upon them to that degree we speak of, and that their joyning to their stalk, and the next parts thereto allow them scope, to obey the impulse of those outward causes. And, when any do vary from this rule we shall as plainly see other manifest causes producing those different effects, as now we do those working in this manner.

As for Fruits, though we see that, when they grow at liberty upon the Tree, they seem to have a particular figure allotted them by nature ; yet in truth, it is the order'd *series* of natural causes, and not an intrinsecal formative virtue which breeds this effect : as is evident, by the great power which art hath to change their figures at pleasure, wherof you may see examples enough in *Campanella* ; and every curious Gardener can furnish you with store.

16.  
The same applied to the bodies of Animals.

Out of these and such like principles, a man that would make it his study (with less trouble of tediousness then that patient contemplator of one of natures little works, the Bees ; whom we mention'd a while ago) might without all doubt, trace the causes in the growing of an *Embryon* ; till he discover'd the reason of every bones figure, of every notable hole or passage in them, of the Ligaments by which they are tied together, of the membranes that cover them ; and of all the other parts of the body. How, out of a first Masse, that was soft and had no such parts distinguishable in it, every one of them came to be formed, by contracting that Masse in one place, by dilating it in another, by moistning it in a third, by drying it here, hard'ning it there ;



— *Ut his exordia primis,*

*Omnia, & ipse tener hominis concreverit orbis.*

till in the end this admirable machine and frame of mans body was composed and fashioned up, by such little and almost insensible steps and degrees. Which, when it is look'd upon in bulk and entirely-formed, seems impossible to have been made, and sprung merely out of these principles; without an *Intelligence* immediately working and moulding it at every turn, from the beginning to the end.

But withall, we cannot chuse but break out into an extasie of admiration and hymns of praise (as great *Galen* did upon the like occasion), when we reverently consider the infinite Wisdom and deep far-looking Providence of the all-seeing Creator and Orderer of the World; in so punctually adopting such a multitude and swarm of causes to produce, by so long a progress, so wonderful an effect: in the whole course of which, if any one, the very least of them all, went never so little awry, the whole fabrick would be discomposed and changed from the nature it is design'd to.

Out of our short survey of which (answerable to our weak talents and slender experience) I perswade my self it appears evident enough, that, to effect this work of generation, there needs not be supposed a forming virtue, or *Vis formatrix*, of an unknown power and operation; as those that consider things suddenly and but in gross use to put. Yet, in discourse, for conveniency and shortness of expression, we shall not quite banish that term from all commerce with us; so that what we mean by it be rightly understood: which is, the complex, assemblment, or chain of all the causes, that concur to produce this effect; as they are set on foot to this end by the great Architect and Moderatour of them, *God Almighty*, whose instrument Nature is: that is, the same thing, or rather the same things, so order'd as we have declared; but express'd and compriz'd under another name,

7.  
In what sense  
the Author  
admits of,  
*vis formatrix*.



## CHAP. XXVI.

*How motion begins in Living Creatures : And of the  
motion of the Heart ; circulation of the Blood ;  
Nutrition, Augmentation, and Cor-  
ruption or Death.*

I.  
From whence  
proceeds the  
primary moti-  
on & growth  
in Plants.

**B**Ut we must not take our leave of this subject, til we have examin'd, how motion begins in living things; as well Plants as Sensative creatures. We can readily pitch upon the part we are to make our observations in, for retriving the origine of this primary motion : for, having concluded, that the roots of Plants, and the hearts of Animals, are the parts of them which are first made, and from which the forming virtue is derived to all the rest ; it were unreasonable to seek for their first motion any where else.

But, in what manner, and by what means doth it begin there ? For roots, the difficulty is not great, for, the moysture of the earth pressing upon the seed, and soaking into it, the hot parts of it, which were imprison'd in cold and dry ones, are therby stir'd up and set on work ; then they, mingling themselves with that moysture, ferment and distend the whole seed, til, making it open and break the skin, more juice comes in : which incorporating it self with the heat, those hot and now moyst parts will not be contain'd in so narrow a room as at the first; but, struggling to get out on all sides, and striving to enlarge themselves, they thrust forth little parts. Which, if they stay in the earth, grow white, and make the root; but those which ascend and make their way into the air, being less compressed and more full of heat and moysture, turn green : and, as fast as they grow up, new moysture coming to the root is sent up through the pores of it ; and this fails not, till the heat of the root it self fails. For, it being the nature of heat to rarifie and elevate, there must of necessity be caus'd in the earth a kind of sucking in of moysture into the root from the next parts to it, to fill those capacities which the dilating heat hath made, that  
else



else would be empty ; and to supply the rooms of those which the heat continually sends upwards : for, the moysture of the root hath a continuity with that in the earth, and therefore they adhere together ( as in a Pump, or rather as in filtration ) and follow one another, when any of them are in motion ; and still the next must needs come in and fill the room, where it finds an empty space immediate to it. The like of which happens to the Air when we breath : for, our lungs being like a Bladder, when we open them the air must needs come in, to fill that capacity which else would be empty ; and when we shut them again, as in a pair of Bellows, we put it out.

This may suffice, concerning the primary motion of roots : but in that of the heart, we shall find the matter not altogether so plain, *Monsieur des Cartes*, following herein the steps of the learned and ingenuous Dr. *Harvey*, who hath invented and teaches that curious and excellent Doctrine of the *Circulation of the Bloud*, ( as indeed, what secret of nature can be hidden from so sharp a wit, when he applies himself to penetrate into the bottome of it ), explicates the matter much after this sort. That the heart, within the substance of it, is like a hollow Cavern in whose bottome were an hot stone, on which should drop as much liquor as the fiery stone could blow into smoke ; and this smoke or steam should be more then the Cave could contain, wherfore it must break out : which to do, it presses on all sides, to get an issue or door to let it out. It finds of two sorts, but only one kind of them will serve it for this purpose ; for the one sort of these doors opens inwards, the other outwards : which is the cause that, the more it strives to get out, the faster it shuts the doors of the first kind ; but, by the same means, it beats back the other doors, and so gets out.

Now, when it is gone quite out of this Cavern, and consequently leaves it to its natural disposition ; whereas before it violently stretched it out, and, by doing so, kept close the doors that open inwards : then, all the parts of it begin to slacken, and those Doors give way to new liquor to drop in anew ; which the heat in the bottome of the heart rarifies again in-

2.  
Mr. des Cartes  
his opinion  
touching the  
motion of the  
heart.



into smoke, as before. And thus he conceives the motion of the heart to be made; taking the substance of it to be (as I may say) like to limber Leather, which, upon the feeling of it with blood and steam, opens and dilates it self; and at the going of it out, it shrinks together like a bladder.

3.  
The former  
opinion reje-  
cted.

But, I doubt this Explication will not go through the difficulty. For first, both *Galen* and *Dr. Harvey* shew, that, as soon as the blood is come into the heart, it contracts it self; which agrees not with *Monfir des Cartes* his supposition: for, in his doctrine, there appears no cause why it should contract it self, when it is full; but contrariwise, it should go on dilating it self; till enough of the blood which drops into the heart were converted into steam, to force the doors open, that so it may gain an issue thence, and a passage into the body.

Next, *Monfir des Cartes* supposes that the substance of the heart is like a bladder, which hath no motion of it self; but opens and shuts, according as what is within it stretches it out, or permits it to shrink and fall together again. Whereas *Dr. Harvey* proves that, when it is full, it compresses itself by a quick and strong motion, to expel that which is in it; and that, when it is empty, it returns to its natural dilatation, figure, and situation; by the ceasing of that agents working, which caused its motion. Wherby it appears to be of such a fibrous substance, as hath a proper motion of its own.

Thirdly, I see not how this motion can be proportional. For, the heart must needs open and be dilated, much faster then it can be shut and shrunk together; there being no cause put to shut and bring it to its utmost period of shrinking, other then the going out of the vapour, wherby it becomes empty: which vapour, not being forced by any thing but its own inclination, may peradventure, at first when there is abundance of it, swell and stretch the heart forcibly out; but, after the first impulse and breach of some part of it out of the Cavern that enclosed it, there is nothing to drive out the rest, which must therefore steam very leasurely out.

Fourth-



Fourthly, what should hinder the blood from coming in before the heart be quite empty and shrunk to its lowest pitch? For as soon as the vapour yeelds within, new blood may fall in from without; and so keep the heart continually dilated, without ever suffering it to be perfectly and compleatly shut.

Fifthly, the heart of a Viper, layd upon a plate in a warm place, will beat four and twenty houres, and much longer, if it be carefully taken out of its body, and the weather warm and moyst: and it is clear, that this is without succession of blood to cause the pulses of it. Likewise, the several members of living creatures will stir for sometime, after they are parted from their bodies: and in them we can suspect no such cause of motion.

Sixthly, *Monsieur des Cartes* his opinion, the heart should be hardest when it is fullest; and the eruption of the steam out of it should be strongest at the beginning; whereas experience shews, that it is softest when it is at the point of being full, and hardest when it is at the point of being empty; and the motion strongest towards the end.

Seventhly, in *Monsieur des Cartes* his way, there is no agent or force strong enough to make blood gush out of the heart. For, if it be the steam only that opens the doors, nothing but it will go out, and the blood will still remain behind; since it lies lower then the steam, and further from the issue that lets it out: but *Dr. Harvey* findes by experience (and teaches how to make this experience) that, when a wound is made in the heart, blood will gush out by spurts at every shooting of the heart.

And lastly, if *Monsieur des Cartes* his supposition were true, the arteries would receive nothing but steams; whereas it is evident, that the chief filler of them is blood.

Therefore we must enquire after another cause of this primary motion of a sensitive creature, in the beatings of its heart. Wherin we shall not be obliged to look far: for seeing we find this motion and these pulsations in the heart, when it is separated from the body; we may boldly and safely conclude, that it must of necessity be caused by something that is

4.  
The Authors  
opinion con-  
cerning the  
motion of the  
heart.



within the heart it self. And what can that be else, but heat or spirits imprison'd in a tough viscous bloud: which it cannot so presently break through to get out; and yet can stir within it, and lift it up?

The like of which motion may be observ'd, in the heaving up and sinking down again of lose mould thrown into a pit, intoe which much ordure hath been emptied. The same cause, of h at in the earth, makes mountains and sands to be cast up in the very sea. So, in frying, when the pan is full of meat, the bubbles rise and fall at the edges. Treacle, and such strong compounded substances, whiles they ferment, lift themselves up and sink down again; after the same manner as the Vipers heart doth: as also do the bubbles of Barm, and most of Wine. And short ends of Lute strings, baked in a juicy pie, will, at the opening of it, move in such sort, as they who are ignorant of the feat will think there are Magots in it: and a hot loaf, in which quicksilver is enclosed, will not only move thus, but will also leap about, and skip from one place to another; like the head or limb of an Animal (very full of spirits) newly cut off from its whole body.

And that this is the true cause of the hearts motion, appears evidently. First, because this virtue of moving is in every part of the heart; as you will plainly see, if you cut out into several pieces a heart, that conservs its motion long after it is out of the Animals belly: for every piece will move; as *Dr. Harvey* assures us by experience, and I my self have often seen, upon occasion of making the great antidote, in which Vipers hearts is a principal ingredient. Secondly, the same is seen in the auricles and the rest of the heart; whose motions are several; though so near together, that they can hardly be distinguished. Thirdly, *Dr. Harvey* seems to affirm, that the blood which is in the ears of the heart, hath such a motion of it self, precedent to the motion of the ears it is in: and that this virtue remains in it, for a little space after the ears are dead. Fourthly, in touching a heart, which had newly left moving, with his finger wetted with warm spittle, it began to move again; as testifying that heat and moisture made this motion. Fifthly, if you touch the Vipers heart over with vinegar, with



with spirit of wine, with sharp white-wine, or with any piercing liquor; it presently dyes: for the acuteness of such substances pierces through the viscous blood, and makes way for the heat to get out.

But, this first mover of an Animal must have something from without to stir it up; else, the heat would lie in it, as if it were dead, and in time would become absolutely so. In Eggs you see this exterior mover, in the warmth of the Hens hatching them: And in *Embryons*, it is the warmth of the mothers womb. But when in either of them, the heart is completely form'd and enclosed in the breast, much heat is likewise enclosed there, in all the parts near about the heart; partly made by the heart itself, and partly caused by the outward heat, which helped also to make that in the heart: and then, although the warmth of the hen or of the mothers womb forsake the heart; yet this stirs up the native heat within the heart and keeps it in motion, and makes it feed still upon new fuel, as fast as that which it works upon decays.

But, to express more particularly how this motion is effected, We are to note, that the heart hath in its ventricles three sorts of fibers. The first go long ways (or are straight ones), on the sides of the ventricles, from the thick *basis* of the heart, towards the little tip or cone of it: the second go cross, or roundways, about the ventricles within the heart; and the third, are transversal or thwart ones. Next, we are to remember, that the heart is fix'd to the body by its base; and hangs loose at the cone. Now then, the fibers being of the nature of such things as will swell and grow thicker by being moisten'd; and consequently shrink up in length and grow shorter, in proportion to their swelling thicker (as you may observe in a loose-wrought hempen rope): it must of necessity follow, that, when the blood falls into the heart (which is of a kind of spongy substance); the fibers, being therewith moist'ned, will presently swell in roundness and shrink in length.

Next, we are to note, that there is a double motion in the heart: the one of opening, which is call'd *Diastole*; the other of shutting, which is term'd *Systole*. And although Dr. *Harvey* seems to allow the opening of the heart to be no motion;

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but

5.  
The motion of the heart depends originally of its fibers irrigated by blood.



but rather a relenting from motion, nevertheless (me thinks) 'tis manifest, that it is not only a compleat motion, but, in a manner, the greater motion of the two, though indeed the less sensible, because it is perform'd by little and little: for in it the heart is drawn by violence from its natural position, which must be (as it is of all heavy things) that by which it approaches most to the center of gravity; and such a position we see it gains by the shutting of it.

Now, to declare how both these motions are effected, we are to consider how, at the end of the *Systole*, the heart is voided and cleansed of all the blood that was in it; whence it follows, that the weight of the blood which is in the auricles, pressing upon the *valvulas* or doors that open inwards, makes its way by little and little into the ventricles of the heart: where it must necessarily swell the fibers, and they being swelled must needs draw the heart into a roundish and capacious figure; which the more it is done, the more blood comes in, and with greater violence. The following effect of which must be, that the weight of the blood, joyn'd to the weight of the heart it self and particularly of the conus or tip (which is more solid and heavy in proportion to its quantity, then the rest of the heart,) must necessarily set the heart into the natural motion of descending according to its gravity; which, consequently, is perform'd by a lively jerk, wherby it comes to pass, that the tip of our heart as it were springs up towards our breast; & the blood is spurted out by other *valvula* (that open outwards) which are aptly disposed to be open'd upon such a motion, and convey it to the arteries.

In the course of which motion, we may note, how the figure of our heart contributes to its springing up towards our breast; for, the line of distance between the *basis* and the tip being longer on that side towards the back, then on the other towards the breast; it must happen that, when the heart shuts and straightens it self, and thereby extends it self to its length, the tip will but out forwards towards the breast.

6.  
An objection  
answer'd a-  
gainst the for-  
mer doctrine.

Against this doctrine, of the motion, and of the *Systole* and *Diastole* of the heart, it may be objected, that beasts hearts do not hang like a mans heart, straight downwards, but rather horizontally; and therefore this motion of gravity cannot have place



place in them : nevertheless, we are sure they beat, and open and shut regularly. Besides, if there were no other cause, but this of gravity, for the motion of a mans heart ; it would follow that one, who were set upon his head or hung by his heels, could not have the motion of his heart : which posture nevertheless, we see men remain in for a pretty while, without any extreme prejudice.

But these difficulties are easily answer'd. For, first, whether beasts hearts lie directly horizontally, or whether the *basis* be fast'ned somewhat higher then the tip reaches, and so makes their heart hang inclining downwards ; still the motion of gravity hath its effect in them. As we may perceive in the heart of a viper lying upon a plate, and in any other thing that of it self swells up, and straight again shrinks down : in which we cannot doubt, but that the gravity, fighting against the heat, makes the elevated parts fall, as the heat makes them rise.

And as for the latter, 'tis evident that men cannot stay long in that posture, without violent accidents ; and, in any little while, we see, the blood comes into their face and other parts, which naturally are situated higher, but by this position become lower then the heart : and much time is not required, to have them quite disorder'd and suffocated ; the blood passing through the heart with too much quickness, and not receiving due concoction there, and falling thence in too great abundance into places that cannot with conveniency entertain it.

But you will insist, and ask, Whether in that posture the heart moves or no ; and how ? And, to speak by guesse in a thing I have not yet made experiences enough to be thoroughly inform'd in ; I conceive, without any great scruple, that it doth move : And that it happens thus, That the heart, hanging somewhat loose, must needs tumble over, and the tip of it lean downwards some way or other ; and so lie in part like the heart of a beast, though not so conveniently accommodated : and then the heat, which makes the viscous blood that is in the substance of the heart to ferment, wil not fail of raising it up ; wherupon, the weight of that side of the heart that is lifted up will presently press it down. And thus, by the alternative operations of these  
causes



causes, the heart will be made to open and shut it self, as much as is necessary for admitting and thrusting out that little and disorderly coming blood, which makes its course through it, for that little space wherein the man continues in that position.

7.  
The Circulation of the Blood, and other effects that follow the motions of the heart.

Now, from these effects wrought in the heart by the moistening of the fibers, two other effects proceed. One is, that the blood is push'd out of every corner of the heart with an impetuosity or velocity: The other is, that by this notion the spirits, which are in the ventricles of the heart and in the blood that is even then heated there, are more and deeper press'd into the substance of the heart, so that you see the heart imbibes fresh vigour, and is strengthened with new spirits, whiles it seems to reject that which should strengthen it.

Again, two other effects follow this violent ejection of the blood out of the heart. One is, that, for the present, the heart is entirely cleans'd of all remainders of blood; none being permitted to fall back, to annoy it. The other is, that the heart finding it self dry, the fibers relent presently into their natural position and extension, and the *valvula* that open inwards fall flat to the sides of the ventricles; and consequently new blood drops in. So that, in conclusion, we see, the motion of the heart depends originally of its fibers irrigated by the blood, and not from the force of the vapour, as *Monsieur des Cartes* supposes.

This motion of the heart drives the blood (which is warm'd and spiritualiz'd, by being boyl'd in this furnace) through due passages into the arteries, whence it runs into the veins: and is a main cause of making and nourishing other parts; as the Liver, the Lungs, the Brains, and whatsoever else depends of those veins and arteries through which the blood goes. Which being ever freshly heated, and receiving the tincture of the hearts nature, by passing through the heart; wherever it staves and curdles, it grows into a substance; of a nature conformable to the heart; though every one of such substances be of exceeding different conditions in themselves; the very grossest excrements not being excluded from some participation of that nature.

But



But, if you desire to follow the blood all along, every step in its progress from the heart round about the body, till it return back again to its center; *Dr. Harvey*, who most acutely teaches this doctrine, must be your guide. He will shew you how it issues from the heart by the Arteries; from whence it goes on warming the flesh till it arrive to some of the extremities of the body: and against it is grown so cool (by long absence from the fountain of its heart, and by evaporating its own stock of spirits without any new supply) that it hath need of being warmed anew, it findes it self return'd back again to the Heart, and is there heated again; which return is made by the Veins, as its going forwards is perform'd only by the Arteries.

And, were it not for this continual circulation of the blood, and this new heating it in its proper caldron, the Heart; it could not be avoided but that the extreme parts of the body would soon grow cold and die. For, flesh being of it self of a cold nature (as is apparent in dead flesh); and being kept warm meerly by the blood that bedews it; and the blood likewise being of a nature that soon grows cold and congeals, unless it be preserv'd in due temper by actual heat working upon it: how can we imagine that they two singly, without any other assistance, should keep one another warm (especially in those parts that are far distant from the heart) by only being together? Surely, we must allow the blood (which is a substance fit for motion) to have recourse back to the heart (where only it can be supply'd with new heat and spirits); and from thence be driven out again by its pulses or strokes, which are its shuttings. And, as fast as it flies out, (like a reeking thick steam, which rises from perfumed water falling upon a heated pan), that which is next before it must flie yet further on, to make way for it; and, new arterial blood still issuing forth at every pulse, it must still drive on what issued thence the last precedent pulse, and that part must press on what is next before it. And thus it fares with the whole mass of blood; which, having no other course but in the body, must at length run round, and by new vessels (which are the veins) return back to the place from whence it issued first: and, by that time it comes thither, it is grown cool and thick, & needs a vigorous restoration of spirits  
and



and a new rarifying, that then it may warm the flesh it passes again through; without which it would suddenly grow stone cold. As is manifest, if, by tying or cutting the arteries, you intercept the blood which is to nourish any part: for then that part grows presently cold and benum'd.

8.  
Of Nutrition.

But, referring the particulars of this doctrine to *Dr. Harvey*, who hath both invented and perfected it: our task in hand calls upon us, to declare in common the residue of motions that all Living Creatures agree in. How *Generation* is perform'd, we have determin'd in the past discourse: Our next consideration then ought to be of *Nutrition* and *Augmentation*. Between which there is very little difference, in the nature of their actions: and the difference of their names is grounded, more upon the different result in the period of them, then upon the thing it self; as will by and by appear. Thus then is the progress of this matter. As soon as a living creature is formed, it endeavours straight to augment it self, and employs it self only about that; the parts of it being yet too young and tender, to perform the other functions which nature hath produced them for. That is to say, the Living Creature at its first production is in such a state and condition, that it is able to do nothing else but, by means of the great heat in it, to turn into its own substance the abundance of moisture that overflows it.

They who are curious in this matter tell us, that the performance of this work consists in five actions; which they call *Attraction*, *Adhesion*, *Concoction*, *Assimilation*, and *Unition*. The nature of *Attraction* we have already declared; when we explicated how the heart and the root sends juice into the other parts of the Animal or Plant: for they, abounding in themselves with inward heat, and besides that, much other circumstant heat working likewise upon them; it cannot be otherwise, but that they must needs suck and draw into them the moisture that is about them.

As for *Adhesion*, the nature of that is likewise explicated; when we shew'd how such parts as are moist, but especially aerial or oily ones, (such as are made by the operation of a soft and continual heat), are catching and easily stick to any body



body they happen to touch: and how a little part of moyſture between two dry parts joyns them together. Upon which occasion, it is to be noted that parts of the ſame kind joyn beſt together: and therefore the powder of glaſs is uſed to ciment broken glaſs withal (as we have touch'd ſomewhere above), and the powder of marble to ciment marble with; and ſo of other bodies. In like manner, *Alchimiſts* find no better expedient to extract a ſmall proportion of ſilver mixed with a great one of gold, then to put more ſilver to it: nor any more effectual way to get out the heart, or tincture, or ſpirits, of any thing they diſtil or make an extract of; then to infuſe its own flegme upon it, and to water it with that. Now, whether the reaſon of this be, that continuity, becauſe it is an unity, muſt be firmeſt between parts that are moſt conformable to one another, and conſequentially neareſt one among themſelves; or whether it be for ſome other hidden cauſe, belongs not to this place to diſcourſe: but in fine ſo it is. And the adheſion is ſtrongeſt of ſuch parts as are moſt conformable to that which needs encrease and nourishment; and that is made up by the other three actions.

Of which, Concoction is nothing elſe but a thickning of that juice which already ſticks to any part of the Animals body, by the good digeſtion that heat makes in it. And Aſſimilation is the effect of Concoction: for, this juice being uſed in the ſame manner, as the firſt juice was that made the part wherto this is to be joyn'd, it cannot chuſe but become like it in ſubſtance; And then, there being no other ſubſtance between, it is of it ſelf united to it, without any further help.

Hitherto this action belongs to Nutrition. But if, on the one ſide, the heat and ſpirituality of the blood, and, on the other ſide, the due temper and diſpoſition of the part be ſuch, as the blood is greedily ſuck'd into the part, (which thereby ſwells to make room for it, and will not let it go away, but turns it into a like ſubſtance as it ſelf is, and is greater in quantity, then what is conſumed and decays continually by tranſpiration: then this action is called likewise Augmentation. Which *Galen* explicates, by a ſport the boys of *Ionia* uſed; who were accuſtom'd to fill a bladder with wind, and, when they could force no more into it, they could rub the bladder; and, after rubbing of it, they found

9.  
Of Arguments  
ration.



found it capable of receiving new breath ; and so they would proceed on, till their bladder were as full, as by use they knew it could be made. Now (saith he) nature doth the like, by filling our flesh and other parts with bloud ; that is to say, it stretches the fibers: but she hath, over and above, a power which the boys had not, namely, to make the fibers as strong after they are stretched to their utmost extension, as they were before they were extended ; whence it happens, that she can extend them again as well as at the first, and this without end, as far as concerns that part.

The reason wherof is, because she extends them by means of a liquor, which is of the same nature as that wherof they were made at first : and from thence it followes, that, by concoction, that liquor settles in the parts of the fibers which have most need ; and so makes those parts as great in the length they are extended to, as they were in their shortness before they were drawn out. Whereby the whole part of the Animal, wherein this happens, grows greater : and, the like being done in every part, as well as in any one single one, the whole Animal becomes bigger ; and is in such sort augmented.

10.  
Of Death and  
Sickness.

Out of all which discourse, we may collect that, in the essential composition of Living Creatures, there may peradventure be a phisical possibility for them to continue always without decay, and so become immortals even in their bodies, if all hurtful accidents coming from without might be prevented. For, seeing that a man, besides the encrease which he makes of himself, can also impart to his children a vertue, by which they are able to do the like ; and to give again to theirs, as much as they receiv'd from their Fathers : 'tis clear, that what makes him die is no more the want of any radical power in him, to encrease or nourish himself ; then, in fire, it is the want of power to burn, which makes it go out. But, it must be some accidental want ; which *Gallen* attributes chiefly to the driness of our bones, and sinews, &c. as you may in him see more at large. For, driness with density allows not easie admittance to moisture, and therefore it causes the heat, which is in the dry body, either to evaporate, or to be extinguish'd : and want of heat is that from whence the failing of life proceeds  
which



which he thinks cannot be prevented by any art or industry.

And herein God hath express'd his great mercy and goodness towards us. For, seeing that, by the corruption of our own nature, we are so immerf'd in flesh and blood, as we should for ever delight to wallow in their mire; without raising our thoughts at any time above that low and brutal condition: he hath engaged us, by a happy necessity, to think of and provide for a nobler and far more excellent state of living, that will never change or end.

In pursuance of which inevitable ordinance, Man (as if he were grown weary and out of love with this life; and scorn'd any *Term* in his farm here, since he cannot purchase the *Fee-simple* of it) hastens on his death by his unwary and rash use of meats, which poyson his blood: and then his infected blood, passing through his whole body, must needs in like manner taint it all at once. For the redress of which mischief, the assistance of physick is made use of: and that, passing likewise the same way, purifies the blood, and recovers the corruption occasion'd by the peccant humour; or other whiles, gathering it together, it thrusts and carries out that evil guest, by the passages contriv'd by nature to disburden the body of unprofitable or hurtful superfluities.

## CHAP. XXVII.

*Of the motions of Sence; and of the Sensible Qualities in general: and, in particular, of those which belong to Touch, Taste, and Smelling.*

**H**AVING thus brought on the course of Nature as high as Living Creatures, whose chief *species* or division is those that have sense; and having declared the operations which are common to the whole tribe of them, which includes both Plants and Animals: 'tis now time we take a particular view of those, whose action and passion is the reason why that chief portion of life is termed sensitive; I mean the Senses, and the qualities by which the outward world comes into the living creature through his senses. Which when we shall have gone through,

I.  
The connexion of the subsequent chapters with the precedent.

we



we shall scarcely have left any qualities among bodies, to plead for a spiritual manner of being or working, that is, for a self-entity an instantaneous operation; which kind of things and properties vulgar Philosophy is very earnest to attribute to our senses: with what reason, and upon what ground let us now consider.

2.  
Of the Senses  
and sensible  
qualities in  
general: And,  
of the end for  
which they  
serve.

These qualities are reduced to five several heads; answerable to so many different ways, whereby we receive notice of the bodies that are without us. And accordingly, they constitute a like number of different Senses: of every one of which we will discourse particularly, when we have examined the natures of the qualities that affect them. But now, all the consideration we shall need to have of them is only this; That it is manifest, the organs in us, by which sensible qualities work upon us, are corporeal, and made of the like ingredients as the rest of our body is: and therefore must of necessity be liable to suffer evil, and receive good (as all other bodies do) from those active qualities which make and mar all things within the limits of Nature. By which terms of Evil and Good, I mean those effects that are averse or conformable to the particular nature of any thing; and thereby tend to the preservation or destruction of that individual.

Now we, receiving from our senses the knowledge we have of things without us, give names to them, according to the passions and affections which those things cause in our senses: which being the same in all mankind (as long as they are consider'd in common, and their effects are look'd upon in gross), all the world agrees in one Notion and Name of the same thing; for every man living is affected by it just as his neighbour is, and as all men else in the world are. As for example; Heat or Cold works the same feeling in every man composed of flesh and blood: and therefore whoever should be ask'd of them would return the same answer, that they cause such and such affects in his sense; pleasing or displeasing to him, according to their degrees, and as they tend to the good or evil of his whole body.

But, if we descend to particulars, we shall find that several men of differing constitutions frame different notions of the same



same things; according as they are conformable or disagreeing to their natures: and accordingly, they give them different names. As when the same liquor is sweet to some mens taste, which to anothers appears bitter: one man takes that for a perfume, which to another is an offensive smell. In the *Turkish Baths*, (where there are many degrees of heat in divers rooms, through all which the same person uses to pass, and to stay a while in every one of them, both at his entrance and going out; to season his body by degrees for the contrary excess he is going to) that seems chilly-cold at his first return, which appear'd melting hot at his going to it: as I my self have often made experience in those Countreys. Beauty and loveliness will shine to one man in the same face, that will give aversion to another. All which proclaims, that the Sensible Qualities of Bodies are not any positive real thing, consisting in an indivisible and distinct from the body it self; but are meerly the very body, as it affects our senses: to discover how they do, which must be our labour here.

Let us therefore begin with considering the difference between sensible and insensible creatures. These later lie exposed to the mercy of all outward agents, that from time to time (by the continual motion which all things are in) come within distance of working upon them: and they have no power to remove themselves from what is averse to their nature; nor to approach nearer what comforts it. But the others, having within themselves a principle of motion, (as we have already declared), are able, whenever such effects are wrought on them, as on the others, upon their own account and by their own action, to remove themselves from what begins to annoy them, and to come nearer to what they find a beginning of good by.

These impressions are made on those parts of us, which we call the Organs of our Senses: and by them give us seasonable advertisements and knowledges, wherby we may govern and order, to the best advantage, our little charge of a body; according to the tune or warnings of change in the great circumstant body of the world, as far as it may concern ours. Which how it is done, and by what steps it proceeds, shall be in the following discourse laid open.



Of this great machine that environs us, we, who are but a small parcel, are not immediately concern'd in every part. It imports not us, for the conservation of our body, to have knowledge of other parts then such are within the distance of working upon us: those only, within whose sphere of activity we are planted, can offend or advantage us; and of them some are near us, others further from us. Those that are next us we discern (according as they are qualified), either by our Touch, or our Taste, or our Smelling: which three Senses manifestly appear to consist in a meer gradation of more or less gross; and their operations are level'd to the three Elements that press upon us, Earth, Water, and Air. By our other two Senses (our Hearing and our Seeing) we have notice of things further off; and the agents which work on them are of a more refined nature.

3.  
Of the sense  
of Touching;  
and that both  
it and its qua-  
lities are bo-  
dies.

But we must treat of them all in particular: and that which we will begin with shall be the Touch; as being the grossest of them, and that which converses with none but the most material and massie objects. We see, it deals with heavy consistent bodies; and judges of them by conjunction to them, and by immediate reception of something from them. And, according to the divers impressions they make in it, it distinguishes them by divers names; which (as we said of the qualities of mixed bodies) are generally reduced to certain pairs: as, hot and cold, wet and dry, soft and hard, smooth and rough, thick and thin, and some others of the like nature; which were needless to enumerate, since we pretend not to deliver the science of them, but only to shew that they and their actions are all corporeal.

And, this is sufficiently evident, by meer repeating but their very names: for 'tis plain by what we have already said, that there are nothing else but certain effections of quantity, arising out of different degrees of rarity and density compounded together. And 'tis manifest, by experience, that our sense receives the very same impressions from them which another body doth. For, our body or our sense will be heated by fire; burned by it too, if the heat be too great; as well as wood: it will be constipated by cold water, moistened by humide things, and dried by dry bodies; in the same manner as any other body  
what-



whatever, Likewise, it may, in such sort as they, be wounded and have its continuity broken by hard things, be pleas'd and polish'd by soft and smooth; be press'd by thick and heavy, and rub'd by those that are rugged, &c.

So that those Masters, who will teach us that the impressions upon sense are made by spiritual or spirit-like things or qualities, (which they call *intentional specieses*), must labour at two works: the one, to make it appear that there are in nature such things as they would perswade us; the other, to prove that these material actions we speak of are not able to perform those effects, for which the senses are given to living creatures. And, till they have done that, I conceive, we should be much too blame to admit such things, as we neither have ground for in reason, nor can understand what they are. And therefore, we must resolve to rest in this belief, which experience breeds in us, that these bodies work on our senses, no other ways then by a corporeal operation; and that such a one is sufficient for all the effects we see proceed from them: as, in the process of this discourse, we shall more amply declare.

The Element immediately next to Earth in grossness is Water. And in it is the exercise of our tast; or Mouth being perpetually wet within; by means of which moisture, our Tongue receives into it some little parts of the substance which we chew in our Teeth, and which passes over it. You may observe how, if we take any herb or fruit, and, having chop'd or beaten it small, put it into a wooden dish of water and squeeze it a little; the juice, communicating and mingling it self with the water, infects it with the tast of it self, and, remaining a while in the bowl, sinks by little and little into the very pores of the wood: as is manifest, by its retaining a long time after the tast and smell of that herb. In like manner, nature hath taught us, by chewing our meat, and by turning it in our mouths and pressing it a little (that we may the more easily swallow it), to imbue our Spittle with such little parts as easily diffuse themselves in water. And then, our Spittle being continue to the moisture within our tongue, (in such sort as we declared of the moisture of the earth, that soaks into the

4.  
Of the Tast  
and, its quali-  
ties: that they  
are bodies.



root of a plant), and particularly in the sinews of it, must of necessity affect those little sensible strings with the qualities which these petty bodies, mixed every where with the moisture, are themselves imbued withal.

And if thou ask, what motions or qualities these be? Physicians (to whom it belongs most particularly to look into them) will tell you, that some dilate the tongue more, and some less; as if some of these little bodies had an aerial, and others a watry disposition: and these two they express by the names of sweet and fatty. That some contract and draw the tongue together; as choaky and rough things do most, and, next to them, crabby and immature sharpness. That some corrode and pierce the Tongue; as Salt and sowre things. That bitter things search the outside of it, as if they swept it: and that other things as it were prick it; as spices and hot drinks. Now all these are sensible material things; which admit to be explicated clearly, by the varieties of rarity and density concurring to their compositions; and are so proportionable to such material instruments, as we cannot doubt but they may be thoroughly declared by our former principles.

5.  
That the  
Smell and its  
qualities are  
real bodies.

The next Element above Water is Air; which our Nostrils being our Instrument to suck in, we cannot doubt but what affects a man by his Nose must come to him in Breath or Air. And, as humidity receives grosser and weightier parts, so those which are more subtile and light rise up into the Air: and these we know attain to this lightness by the commixtion of fire, which is hot and dry. And therefore we cannot doubt, but that the nature of Smells is more or less tending to heat and drought: which is the cause that their commixtion with the brain proves comfortable to it; because, of its own disposition, it is usually subject to be too moist and too cold.

Whether there be any immediate instrument of this sense to receive the passion or effect, which by it other bodies make upon us, or whether the sense it self be nothing but a passage of these exhalations and little bodies to the brain, fitly accommodated to discern what is good or hurtful for it, and accordingly to move the body to admit or reject them; it imports not



not us at present to determine : let Physicians and Anatomists resolve that question, Whiles it suffices us to understand, that the operations of bodies by Odours upon our sense, are perform'd by real and solid parts of the whole substance; which are truly material, though very little bodies; and not by imaginary qualities.

And those bodies, when they proceed out of the same things that yield also tastive particles, (although without such material violence, and in a more subtile manner), must of necessity have in them the same nature, which those have that affect the tast; and they must both of them affect a man much alike, by his tast by his smell: and so are very proportionate to one another; excepting in those properties which require more cold or liquidity then can well stand with the nature of a smell. And accordingly, the very names, which men have imposed to express the affections of both, many times agree; as *savour* and *sweet* which are common both to the smell and tast; the strongest of which we see oftentimes make themselves known, as well by the one as by the other sense; and either of them in excess will turn a mans stomach. And, the Physicians that write of these senses find them very conformable: whence it happens that the losing of one of them is the losse also of the other.

And, experience teaches us in all Beasts, that the Smell is given to living creatures, to know what meats are good for them, and what are not. And accordingly, we see them still smell for the most part at any unknown meat, before they touch it; which seldom fails of informing them rightly: nature having provided this remedy against the gluttony, which could not choose but follow the convenient disposition and temper of their parts and humours; through which they often swallow their meat greedily and suddenly, without expecting to try it first by their tast. Besides that, many meats are so strong, that their very tasting them after their usual manner would poison, or at least greatly annoy them: and therefore nature hath provided this sense, to prevent their tast; which being far more subtile then their tast, the *finer* atoms by which it is perform'd are not so very noxious to the health of the Animal, as the other grosser atoms are.

6.  
Of the conformity betwixt the two Senses of Smelling and Tasting.

*finer*



7.  
The reason  
why the sense  
of Smelling  
is not so per-  
fect in man as  
in beasts: with  
a wonderful  
history of a  
man who  
could wind a  
scent as a well  
as any beast.

And doubtless, the like use men would make of this sense; had they not, on the one side, better means then it to know the qualities of meats, and therefore, this is not much reflected on: And, on the other side, were they not continually stuff'd and clogg'd with gross vapours of steamy meats, which are daily reeking from the Table and their stomachs; and permit not purer Atomes of bodies to be discerned, which require clear and uninfected organs to take notice of them. As we see it fare with doggs: who have not so true and sensible noses, when they are high fed, and lie in the kitchen amidst the steams of meat; as when they are kept in their kennel, with a more spare diet, fit for hunting.

One full example this age affords us in this kind; of a man, whose extremity of fear wrought upon him to give us this experiment. He was born in some Village of the Countrey of *Liege*: and therefore, among strangers, he is known by the name of *John of Liege*. I have been informed of this story by several, (whom I dare confidently believe) that have had it from his own mouth; and have question'd him, with great curiosity, particularly about it.

When he was a little boy, there being wars in the Countrey, (as that State is seldom without molestations from abroad, when they have no distempers at home, which is an inseparable effect of a Countries situation upon the Frontiers of powerful neighbouring Princes that are at variance), the village of whence he was had notice of some unruly scatter'd Troups that were coming to pillage them: which made all the people of the village flee hastily with what they could carry with them, to hide themselves in the woods; which were spacious enough to afford them shelter, for they joyn'd upon the *Forrest of Ardenne*. There they lay, till some of their Scouts brought them word, that the Souldiers, of whom they were in such apprehension, had fired their Town and quitted it. Then all of them return'd home, excepting this boy: who, it seems, being of a very timorous nature, had images of fear so ströng in his phantasie, that first he ran further into the wood then any of the rest, and afterwards apprehended that every body he saw through the thickets, and every voice he heard, was the Souldiers; and so hid himself from  
his



his parents, that were in much distress seeing him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they return'd home without him; and he lived many years in the woods, feeding upon roots and wild fruits, and mast.

He said that, after he had been some time in this wilde habitation, he could by the smell judge of the taste of any thing that was to be eaten: and that he could, at a great distance, wind by his nose, where wholesome fruits or roots grew. In this state he continu'd (still shunning men with as great fear as when he first ran away; so strong the impression was, and so little could his little reason master it): till, in a very sharp winter, when many beasts of the forest perish'd for want of food, necessity brought him to so much confidence, that, leaving the wild places of the forest, remote from all peoples dwellings, he would, in the evenings, steal among cattel that were fothered; especially the Swine, and, among them, glean that which serv'd to sustain wretchedly his miserable life. He could not do this so cunningly, but that, returning often to it, he was on a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair), believing him to be a Satyre or some such prodigious creature as the recounters of rare accidents tells of, laid wait to apprehend him: But he, that winded them as far off as any beast could do, still avoided them; till at length, they laid snares for him, and took the wind so advantageously of him, that they caught him: and then soon perceiv'd he was a man, though he had quite forgotten the use of all language; but by his gestures and cries he express'd the streatest affrightedness that might be. Which afterwards he said (when he had learn'd a new to speak) was because he thought those were the souldiers he had hidden himself to avoid, when he first betook himself to the Wood; and were alwayes lively in his phantasie, through his fears continually reducing them thither.

This man, within a little while after he came to good keeping and full feeding, quite lost that accuteness of smelling, which formerly govern'd him in his taste; and grew to be in that particular as other ordinary men were. But, at his first living with  
other



other people, a woman (that had compassion of him, to see a man so near like a beast, and that had no language to call for what he wish'd or needed to have) took particular care of him; and was alwayes very sollicitous to see him furnish'd with what he wanted: which made him so apply himself unto her in all his occurrences, that, whenever he stood in need of ought, if shee were out of the way, and were gone abroad in the fields, or to any other village near by, he would senter out presently by his scent; in such sort as with us those dogs use to do which are taught to draw dry foot. I imagine he is yet alive, to tell a better story of himself then I have done; and to confirm what I have here said of him: for, I have from them who saw him but few years agoe, that he was an able strong man, and likely to last yet a good while longer.

And, of another man I can speak assuredly my self; who, being a very temperate or rather spare diet, could likewise perfectly discern by his smel the qualities of whatever was afterwards to pass the examination of his taste, even to his bread and bear. Wherefore to conclude, 'tis evident both by reason and experience, that the objects of our Touch, our Taste, and our Smel, are material and corporeal things, derived from the division of quantity into more rare and more dense parts; and may with ease be resolved into their heads and springs, sufficiently to content any judicious and rational man. Who, if he be curious to have further satisfaction in this particular (as far as concerns odours and favours), may look over what *Johannes Bravus* (that judicious, though unpolish'd, Physitian of *Salamanca*) hath written thereof.



## CHAP. XXVIII.

*Of the sense of Hearing, and of the sensible quality, Sound.*

**B**Ut, to proceed with the rest of the Senses. Because nature saw, that some things came suddenly upon a living creature, which might do it hurt, if they were not perceiv'd afar off; and that other things were placed at distance from it; which would greatly help it, if it could come near to them: she found a means to give us two Senses more, for the discovery of remote things. The one, principally and particularly, to descry their motion. The other, to mark their bulk and situation.

1.  
Of the sense of  
Hearing: and  
that Sound is  
purely motion

And so, to begin with the former of these; we must needs acknowledge (after due examination of the matter) that the thing which we call sound is purely motion. And if it be objected, that many motions are made without any discernable Sound; We shall not make difficulty to grant it; considering that many motions dye before they come to touch the ear; or else are so weak, that they are drown'd by other stronger motions; which round about Besiege our ears in such manner, that notice is not taken of these. For, so it fares in what depends meerly of quantity, especially concerning our senses; that not every thing of the kind, but a determinate quantity or multitude of parts of it, makes an object sensible.

But, to come close to the point: We see that Sound, for the most part, is made in the air; and that, to produce it, there is required a quick and smart motion of that Element, which, of all the the rest, is the most moveable. And, in motion, velocity or quickness is proportionate to density in magnitude (as we have at large declared): Which makes quantity become perceptible in bulk, as this doth in motion. And, as the one consists in a greater proportion of substance to the same quantity; so the other doth, in the passage of more parts of the *medium* in the same time.

And, in the moderating of this, such of the Liberal Arts are employ'd, as belong to the cultivating mans voice; as Rhetorick, Meetering, and Singing. 'Tis admirable how finely Ga-

A a

Lileo



2.  
Of divers arts  
belonging to  
the sense of  
Hearing: all  
which cons  
firm that  
Sound is  
nothing but  
motion.

li'eo hath deliver'd us the consonances of Musick ( towards the end of his *First Dialogue, of Motion*; from the 95 page, forward on). and now he hath shew'd that matter clearly to the sight (so making the eye as well as the ear Judge of it), in motions of the water, in Pendants hanging loose in the air, and in permanent notes or traces made upon letton. To the moderation of the same, many other mechanical arts are imply'd; as the Trade of Belfounders, and of all Makers of musical instruments by wind, or by water, or by strings.

Neither can I slip over without mention the two curious Arts of Echoing and Whispering. The first of which teaches to iterate voices several times; and is frequently put in practice by those, that are delighted with rarities in their gardens: And the other shews how to gather into a narrow room the motions of the air; that are diffused in a great extent; wherby one that shall put his ear, to that place where all the several motions meet, shall hear what is spoken so low, as no body between him and the speaker can discern any sound at all. Of which kind there are very fine curiosities in some Churches of *England*: and myself have seen in an upper room of a capacious round Tower vaulted overhead, the walls so contrived (by chance I believe); that two men, standing at the utmost opposite points of the Diameter of it, could talk very currently and clearly with one another, and yet none that stood in the middle could hear a syllable. And, if one turn'd his face to the wall and spoke against that (though never so softly); the others ear, at the opposite point, would discern every word. Which puts me in mind of a note made by one that was no friend to Auricular Confession, (upon occasion of his being with me in a Church that had been of a Monastery); where, in one corner of it, one might sit and hear almost all that was whisper'd through the whole extent of the Church: who would not be perswaded but that it was on purpose contrived so by the subtilty of the Friars; to the end that the Prior, or some of them, might sit there and hear whatever the several Penitents accused themselves of to their Ghostly Fathers, so to make advantage by this artifice, of what the Confessors durst not of themselves immediately reveal.

He allow'd better of the use in *Rome*, of making voyces rebound



bound, from the top of the *Cupula* of *St. Peters* in the *Vatican*, down to the floor of the Church; when, on great days, they make a Quire of Musick go up to the very highest part of the arch, which is, into the Lanthorn: from whence while they sing, the people below just under it are surpris'd with the smart sound of their voices, as though they stood close by them, and yet can see no body from whom these notes should proceed. And in the same *Cupula*, if two men stand upon the large cornish or border, which circles the bottom of it; they may observe the like effect as that I spoke of above in the round Tower.

In like manner, they that are called *Ventriloqui*, perswade ignorant people, that the Devil speaks from within them (deep in their belly); by their sucking their breath inwards, in a certain manner, while they speak: whence it follows, that their voice seems to come not from them, but from somewhat else hidden within them; if at least you perceive it comes out of them; but, if you do not, then it seems to come from a good way off.

To this art belongs the making of *Sarabatanes* or *Trunks*, to help the hearing; and of *Echo-glasses*, that multiply sounds, as *Burning-glasses* do light. All which arts, and the rules of them, follow the laws of motion; and every effect of them is to be demonstrated by the principles and proportions of motion: therefore, we cannot with reason imagine them to be any thing else.

We see likewise, that great noises, not only offend the hearing, but even shake houses and Towers. I have been told by inhabitants of *Dover*, that, when the *Arch-Duke Albertus* made his great battery against *Calais* (which for the time was a very furious one; for he endeavor'd all he could to take the Town before it could be reliev'd): the very houses were shaken, and the glass-windows shiver'd, with the report of his Artillery. And I have been told by one that in *Sevill*, when the gunpowder-house of that Town (which was some two miles distant from that place where he lived) was blown up; that it made the wooden shutters of the windows in his house beat and clap against the walls with great violence: and split the very walls of a fair Church, that, standing next it (though at a good distance), and no other building between to shelter it from the

3.  
The same is confirm'd by the effects caused by great noises.



impetuosity of the airs sudden violent motion;

And, after a fight I once had with some Galleasses and Gallions in the roade of *Scanderone* ( which was a very hot one for the time, and a scarce credible number of pieces of Ordnance were shot from my Fleet ); the English Consul of that place coming afterwards aboard my ship told me, that the report of our guns had, during all the time of the fight, shaken the drinking-glasses that stood upon shelves in his house, and split the paper-windows all about, and spoil'd and crack'd all the eggs that his Pigeons were then sitting upon: which loss he lamented exceedingly; for they were of that kind which commonly is called *Carriers*, and serve them daily in their commerce between that place and *Aleppo*.

And, I have often observed at Sea, in smooth water, that the Ordnance shot off, in a ship some miles distant, would violently shake the glass-windows in another: And I have perceiv'd this effect in my own, more then once; at the report of a single gun from a ship, so far off, that we could not descry her. I remember how, one time upon such an occasion, we alter'd our course and steer'd with the sound, or rather with the motion at first; observing upon which point of the Compass the shaking appear'd (for we heard nothing, though soon after, with much attention and silence, we could discern a dull clumlie noise). And such a motion grows at the end of it so faint, that, if any strong resisting body check it in its course, 'tis presently deaded and will afterwards shake nothing beyond that body: and therefore 'tis perceptible onely at the outside of the ship, if some light and very moveable body hang loosely on that side it comes, to receive the impression of it; as this sound at the gallery windows of my Cabin upon the poop, which were of light *Moscovia* glass. And by then we had run somewhat more then a watch, with all the sails abroad we could make, and in a fair loom gale; we found our selvs near enough to part the fray of two ships, that, in a little while longer fighting would have sunk one another.

That solid bodies may convey the motion of the ayr or sound to the organ of hearing.

But, besides the motions in the air (which receiv'd them easily, by reason of the fluidity of it); we see that even solid bodies participate of it. As, if you knock never so lightly at one end of the longest beam you can find; it will be distinctly heard at the other end. The trampling of men and horses, in a quiet night, will be



be heard some miles off, if one lay their ear to the ground; and more sensibly, if one make a little hole in the earth, and put ones ear into the mouth of it: but most of all, if one set a Drum smooth upon the ground, and lay ones ear to the upper edge of it; for, the lower membrane of the Drum is shaken by the motion of the earth, and then multiplies that sound by the hollow figure of the Drum, in the conveying it to the upper membrane upon which your ear leans. Not much unlike the Tympane or Drum of the ear; which, being shaken by outward motion, causes a second motion on the inside of it correspondent to this first; and this, having a free passage to the brain, strikes it immediately, and so informs it how things move without; which is all the mystery of hearing.

If any thing break or stop this motion, before it shake our ear, it is not heard. And accordingly, we see that the sound of Bells or Artillery is heard much further, if it have the conduct of waters, then through the pure air: because in such bodies, the great continuity of them makes that one part cannot shake alone, and upon their *superficies* there is no notable unevenness, nor any dense thing in the way to check the motion (as in the air, hills, buildings, trees, and such like;) so that the same shaking goes a great way. And, to confirm that this is the true reason, I have several times observ'd that, standing by a river side, I heard the sound of a ring of Bells much more distinctly and loud, then if I went some distance from the water, though nearer to the steeple from whence the sound came.

And it is not only the motion of the air, that makes sound in our ears: but any motion that hath access to them, in such a manner as to shake the quivering membranous Tympane within them, will represent to us those motions which are without, and so make such a sound there as if it were convey'd onely by the air. Which is plainly seen, when a man, lying a good way under water, shall there hear the same sounds, as are made above in the air; but in a more clumsy manner; according as the water, by being thicker and more corpulent, is more unwieldy in its motions. And this I have tryed often; staying under water as long as the necessity of breathing would permit me. Which shews that the air, being smartly moved, moves the water also, by means of its continuity with it; and that li-

5.  
Where the motion is interrupted, there is no sound.

6.  
That not only the motion of the air, but all other motions coming to our ears, make sounds.



7.  
How own  
sense may sup-  
ply the want  
of an other.

quid element, being fluide and getting into the ear, makes vibrations upon the drum of it like to those of air.

But all this is nothing, in respect of what I might in some sort say, and yet speak truth. Which is, that I have seen one, who could discern sounds with his eyes. 'Tis admirable, how one sense will oftentimes supply the want of another : whereof I have seen an other strange example, in a different strain from this ; of a man that, by his grosser senses, had his want of sight wonderfully made up. He was so thoroughly blind, that his eyes could not inform him when the Sun shined ; for all the crystalline humour was out in both his eyes : yet his other senses instructed him so efficaciously, in what was their office to have done, as what he wanted in them seem'd to be overpay'd in other abilities. To say that he would play at Cards and Tables, as well as most men, is rather a commendation of his memory & phantasie, then of any of his outward senses : But, that he should play well at Bowles and Shovelbord and other games of aim, which in other men require clear sight and an exact level of the hand, according to the qualities of the earth or table, and to the situation and distance of the place he was to throw at : seems to exceed possibility. And yet he did all this.

He would walk in a chamber, or long alley in a garden (after he had been a while used to them) as straight, and turn as just at the ends, as any seeing man could do. He would go up and down every where so confidently, and demean himself at table so regularly ; as strangers have sitten by him several meals, and seen him walk about the house, without ever observing any want of seeing in him : which he endeavour'd what he could to hide, by wearing his hat low upon his brows. He would, at the first abord of a stranger, as soon as he spoke to him, frame a right apprehension of his stature, bulk and manner of making. And, which is more, when he taught his Schollers to declame (for he was School-master to my sons, and lived in my house) or to represent some of *Seneca's Tragedies*, or the like ; he would by their voice know their gesture, and the situation they put their bodies in : so that he would be able, as soon as they spoke, to judge whether they stood or sate, or in what posture they were ; which made them demean themselves as decently before him whiles they spoke, as if he had seen them perfectly.

Though



Though all this be very strange, yet me thinks his discerning of lights is beyond it all. He would feel in his body, and chiefly in his brain (as he hath often told me) a certain effect, by which he knew when the Sun was up; and would discern exactly a clear from a cloudy day. This I have known him frequently do without missing, when, for trial sake, he has been lodged in a close chamber, whereto the clear light or Sun could not arrive, to give him any notice by its actual warmth: nor any body could come to him, to give him private warnings of the Changes of the weather,

But this is not the relation I intended, when I mention'd one that could hear by his eyes; (if that expression may be permitted me). I then reflected upon a Noble man of great quality that I knew in *Spain*; the younger brother of the Constable of *Castile*. But, the reflection of his seeing of words, call'd into my remembrance the other that felt light: in whom I have often remark'd so many strange passages, with amazement and delight; that I have adventured upon the Readers patience to record some of them, conceiving they may be of some use in our course of doctrine. But, the Spanish Lord was born deaf; so deaf, that, if a Gun were shot off close by his ear, he could not hear it: and consequently, he was dumb; for not being able to hear the sound of words, he could never imitate nor understand them. The loveliness of his face, and especially the exceeding life and spiritfulness of his eyes, and the comeliness of his person & whole composure of his body throughout, were pregnant signs of a well temper'd mind within: and therefore all that knew him lamented much the want of means to cultivate it, and to imbue it with the motions which it seem'd capable of, in regard of its self; had it not been so cross'd by this unhappy accident. Which to remedy, Physitians and Chyrurgians had long imploy'd their skill; but all in vain: at last, there was a Priest who undertook the teaching him to understand others when they spoke, and to speak himself that others might understand him. What at the first he was laugh'd at for, made him, after some yeers, be looked on as if he had wrought a miracle. In a word, after strange patience, constancy and pains, he brought the young Lord to speak as distinctly as any man whoever; and to understand so perfectly what

4.  
Of one who  
could discern  
sounds of  
words with  
his eyes.



others said, that he would not lose a word in a whole days conversation.

They who have a curiosity, to see by what steps the Master proceeded in teaching him, may satisfie it by a Book which he himself hath written in Spanish upon that subject, to instruct others how to teach deaf and dumb persons to speak. Which when one shall have looked heedfully over, and consider'd what a great distance there is between the simplicity and nakedness of his first principles, and the strange readiness and vast extent of speech resulting in process of time out of them: we will forbear pronouncing an impossibility in their pedigree, whiles he wonders at the numerous effects resulting in bodies out of rarity and density, ingeniously mingled together by an all-knowing Architect, for the production of various qualities among mixts, of strange motions in particular bodies, and of admirable operations of life and sense among vegetables and animals. All which are so many several words of the mystical language; in which the Great Master hath taught his otherwise-dumb schollars (the Creatures), to proclaim his infinite art, wisdom, perfections, and excellency.

The Priest who, by his book and art, occasion'd this discourse, I am told is still alive, and in the service of the Prince of *Carrignan*; where he continues (with some that have need of his pains) the same imployment he had with the *Constables brother*: with whom I have often discoursed, whiles I waited on the *Prince of Wales* (now our gracious Sovereign) in *Spain*. And I doubt not but *His Majesty* remembers all I have said of him, and much more: for, *His Majesty* was very curious to observe and enquire into the utmost of it. It is true, one great misbecomingness he was apt to fall into, whiles he spoke; which was, an uncertainty in the tone of his voyce: for, not hearing the sound he made when he spoke, he could not steadily govern the pitch of his voyce; but it would be sometimes higher, sometimes lower; though, for the most part, what he deliverd together he ended, in the same key as he begun it. But, when he had once suffered the passages of his voyce to close; at the opening them again, chance, or the measure of his earnestness to speak or reply, gave him his tone: which he was not capable of moderating by such an artifice, as 'tis recorded *Caius Gracchus* used, when



when passion, in his Orations to the people, drove out his voyce with too great a vehemence or shrilness.

He could discern in another, whether he spoke shril or low: and he would repeat after any body any hard word whatever. Which the Prince tryed often; not only in *English*, but by making some *Welchmen* that served his Highness speak words of their language: Which he so perfectly ecchoed, that I confess I wonder'd more at that, then at all the rest. And his Master himself would acknowledg, that the rules of his art reach'd not to produce that effect with any certainty: and therefore concluded, this in him must spring from other rules he had framed to himself, out of his own attentive observation; which, the advantage that nature had justly given him in the sharpness of his other senses, to supply the want of this, endow'd him with an ability and sagacity to do, beyond any other man that had his hearing. He express'd it (surely) in a high measure, by his so exact imitation of the *Welch* pronunciation: for, that tongue (like the *Hebrew*) employs much the guttural Letters; and the motions of that part which frames them cannot be seen or judg'd by the eye, otherwise then by the effect they may happily make by consent in the other parts of the mouth, exposed to view. For, the knowledg he had of what they said sprung, from his observing the motions they made: so that he could converse currently in the light, though they he talked with whisper'd never so softly: and I have seen him, at the distance of a large chambers breadth, say words after one, that I, standing close by the speaker could not hear a syllable of. But, if he were in the dark, or if one turned his face out of his sight, he was capable of nothing one said.

But, 'tis time we return to our theam; from whence my blind Schoolmaster, and this deaf Prince (whose defects were over-pai'd an other way) have carried us with so long a digression: which let yet will not be altogether useless (no more then the former, of the wild man of *Liege*); if we make due reflections on them. For, when we shall consider, that Odors may be tasted, that the relish of meats may be smelled, that magnitude and figure may be heard, that light may be felt, and that sounds may be seen; (all which is true in some sense): we may by this changing the offices of the senses, and by looking

9.  
Divers reasons  
to prove sound  
to be nothing  
else but a mo-  
tion of some  
real body.

into.



into the causes thereof, come to discern, that these effects are not wrought by the intervention of airy qualities; but by real and material applications of bodies, to bodies, which, in different manners, make the same results within us.

But when I suffer'd my pen to be steer'd by my phantasie, that pleas'd it self and rioted in the remembrance of these two notable persons: I was speaking, how the strong continuity of the parts of a thing that is moved draws on the motion, and consequently the sound, much further than wherethat which is moved suffers breaches, or the rarity of it occasions that one part may be moved without another; for, to the proportion of the shaking, the noise continues. As we see in trembling Bells, that hum a great while longer then others, after the Clapper has stricken them: and the very sound seems to quiver and shake in our ears, proportionable to the shaking of the Bell. And in a Lute, as long as a string that hath been stricken shakes sensibly to our eye; so long, and to the same measure, the sound shakes in our ear. Which is nothing else but an undulation of the Air, caused by the smart and thick vibrations of the cord, and multiply'd in the belly of the instrument (which is the reason that the concave figure is affected in most): and so, when it breaks out of the instrument, in greater quantity then the string immediately did shake; it causes the same undulations in the whole body of Air round about. And that, striking the Drum of the ear, gives notice therein what tenour the string moves; whose vibrations if one stop, by laying his finger upon it, the sound is instantly at an end: for then there is no cause on foot that continues the motion of the Air; which, without a continuation of the impulse, returns speedily to quiet; through the resistance made to it by other parts of it that are further off.

Out of all which is plain, that motion alone is able to effect, and give account of all things whatever that are attributed to Sound: and that Sound and motion go hand in hand together; so that whatever is said of the one is likewise true of the other. Wherefore, it cannot be deny'd but that hearing is nothing else, but *the due perception of motion*: and that motion and sound are in themselves one and the same thing, though express'd by different names, and comprised in our understanding



derstanding under different notions. Which proposition seems to be yet further convinced, by the ordinary experience of perceiving musick by mediation of a stick: for, how should a deaf man be capable of musick by holding a stick in his Teeth, whose other end lies upon the *Vial* or *Virginals*; were it not that the proportional shaking of the stick (working a like dancing in the mans head) make a like motion in his brain, without passing through his ear; and consequently, without being otherwise sound, then as bear motion is sound.

Or, if any man will still persist in having sound be some other thing then as we say; and that it effects the sense otherwise then purely by motion: he must nevertheless acknowledge that, whatever it be, it hath neither cause nor effect, nor breeding, nor dying, that we either know or can imagine. And then, if he will let reason sway, he will conclude it unreasonable to say or suspect so ill grounded a surmise, against so clear and solid proofs: which our ears themselves not a little confirm, their whole figure and nature tending to the perfect receiving, conserving, and multiplying the motions of air which happen without a man; as, who is curious may plainly see, in the Anatomists books and discourses.

## CHAP. XXIX.

### *Of Sight, and Colours.*

**T**HERE is yet left the object of our Sight, which we call Colours, to take a survey of; for, as for light, we have at large display'd the nature and properties of it; from which whether colour be different or no, will be the question we shall next discuss. For, those who are cunning in Opticks will, by refractions and reflexions, make all sorts of colours out of pure light: as we see in Rainbows, in those Triangular Glasses or Prisms (which some call Fools Paradises), and in other inventions for this purpose. Wherefore in brief, to shew what colour is, let us lay for a ground, that Light is, of all other things in the world, the greatest and the most powerful agent upon our eye; either by it self, or by what comes in with it: and

that,

*r.*  
That Colours  
are nothing  
but light  
mingled with  
darkness; or  
the disposition  
of a bodies su-  
pericies, apt  
to refl. & light  
so mingled.



that, where light is not, darkness is. Then consider, that light may be diversly cast; especially through or from a transparent body; into which it sinks in part, and in part it doth not: and you will conclude, that it cannot choose but come out from such a body, in divers sorts mingled with darkness. Which, if it be in a sensible quantity, accordingly makes divers appearances; and those appearances must of necessity have divers hues, representing the colours which are middle colours between white and black: since white is the colour of light, and darkness seems black. Thus those colours are ingendred, which are call'd apparent ones. And they appear sometimes but in some one position; as in the Rainbow, which changes place as the looker on doth: but, at other times, they may be seen from any part; as those which light makes by a double refraction through a Triangular Glass.

And that this is rightly deliver'd may be gather'd, out of the conditions requisite to their production. For that Chrystal, or water, or any refracting body doth not admit light in all parts, is evident by reason of the reflection it makes, which is exceeding great; and, not only from the *superficies*, but even from the middle of the body within: as you may see plainly, if you put it in a dark place and enlighten but one part of it, for then you may perceive, as it were, a current of light pass quite through the body, although your eye be not opposite to the passage; so that manifestly, it reflects to your eye from all the inward parts which it lights upon.

Now, a more oblique reflection or refraction more disperses the light, and admits more privations of light in its parts, then a less oblique one: as *Galileo* hath demonstrated, in the *First Dialogue* of his *Systeme*. Wherefore a less oblique reflection or refraction may receive that in quality of light, which a more oblique one makes appear mingled with darkness; and consequently, the same thing will appear colour in one, which shews it self plain light in another; for, the greater the inclination of an angle is, the greater also is the dispersion of the light.

And, as colours are made in this sort, by the *medium* through which light passes; so, if we conceive the *superficies* from which the light reflects to be diversly order'd in respect of reflexion;



on, it must of necessity follow, that it will have a divers lustre and sight : as we see by experience in the necks of Pigeons, and in certain positions of our eye ; in which the light, passing through our eye-brows, makes an appearance, as though we saw divers colours streaming from a candle we look upon. And accordingly we may observe, how some things, or rather most, appear of a colour more inclining to white, when they are irradiated with a great light, then when they stand in a lesser. And we see Painters heighten their colours, and make them appear lighter, by placing deep shadows by them ; even so much, that they will make objects appear nearer and further off, meerly by their mixtion of their colours : Because objects, the nearer they are, the more strongly and lively they reflect light, and therefore appear the clearer, as the others do more dusky.

Wherefore, if we put the *superficies* of one body to have a better disposition for the reflection of light, then another hath ; we cannot but conceive, that such difference in the *superficies* must needs beget variety of permanent colours in the bodies : and, according as the *superficies* of the same body is better or worse disposed to reflection of light, by polishing, or by compressure together, or the like ; so, the same body, remaining the same in substance, will shew it self of a different colour. And, it being evident, that white ( which is the chiefest colour ) reflects most light, and as evident, that black reflects least light ( so that it reflects shadows in lieu of colours, as the *Obsidian stone* among the *Romanes* witness ), as also, that, to be dense and hard and of small parts is the disposition of the object which is most apt to reflect light : we cannot doubt, but that *white* is that disposition of the *superficies*. That is to say, It is the *superficies* of a body consisting of dense, of hard, and of small parts ; and on the contrary side, black is the disposition of the *superficies*, which is most soft and full of greatest pores : for, when light meets with such a *superficies*, it gets easily into it ; and is there as it were absorbed and hidden in caves, and comes not out again to reflect towards our eye.

This doctrine of ours, of the Generation of Colours, agrees exactly

2.  
Concerning  
the disposition  
of those bo-  
dies, which  
produce white  
or black co-  
lours.



3.  
The former  
doctrine con-  
firm'd by  
*Aristotles* au-  
thority, reason,  
& experience.

exactly with *Aristotles* principles; and follows evidently out of his definitions of *Light*, and of *Colours*. ( And, for summing up the general sentiments of mankind, in making his Logical definitions; I think none will deny his being the greatest Master that ever was). He defines *Light* to be *actus Diaphani*; which we may thus explicate: It is that thing which makes a body, that hath an aptitude or capacity of being seen quite through in every interior part of it, to be actually seen quite through, according to that capacity of it. And he defines *Colours* to be: The term or ending of a diaphanous body: the meaning wherof is, That Colour is a thing which makes a diaphanous body reach no further, or, the cause why a body is no further diaphanous, then till where it begins; or, that Colour is the reason why we can see no further, then to such a degree, through or into such a body.

Which definition fits most exactly with the thing it gives us the nature of. For, 'tis evident that, when we see a body, the body we see hinders us from seeing any other, that is in a straight line beyond it: and therefore, it cannot be denied, but that Colour terminates and ends the diaphaneity of a body by making it self be seen. And, all men agree in conceiving this to be the nature of Colour; and that it is, a certain disposition of a body, wherby that body comes to be seen. On the other side, nothing is more evident, then that, to have us see a body, light must reach from that body to our eye. Then, adding to this what *Aristotle* teaches concerning the production of seeing; which, he sayes, is made by the action of the seen body upon our sense: it follows, that the object must work upon our sense, either by light, or at least with light; for, light rebounding from the object round about by straight lines some part of it must needs come from the object to our eye. Therefore, by how much an object sends more light to our eye, by so much that object works more upon it.

Now, seeing that divers objects send light in divers manners to our eye, according to the divers natures of those objects in regard of hardness, density, and littleness of parts: we must agree, that such bodies work diversly, and make different motions or impressions upon our eye; and consequent-ly,



ly, the passion of our eye from such objects must be divers. But, there is no other diversity of passion in the eye from the object, in regard of seeing, but that the object appear divers to us in point of Colour. Therefore we must conclude, That divers bodies (I mean divers or different, in that kind we hear talk of) must necessarily seem to be of divers colours, meerly by the sending of light to our eye in divers fashions. Nay, the very same object must appear of different colours, whenever it happens that it reflects light differently to us. As we see in Cloth, if it be gather'd together in foulds, the bottoms of those foulds shew to be of one kind of colour; and the tops of them, or where the cloth is stretch'd out to the full percussion of light, appears to be of another much brighter colour: And accordingly, Painters are fain to use almost opposite colours to express them. In like manner, if you look upon two pieces of the same cloth, or plush, whose grains lie contrariwise to one another, they will likewise appear to be of different colours: Both which accidents, and many other like them in begetting various representations of Colours arise out of lights being more or less reflected from one part then from another.

Thus then you see, how Colour is nothing else, but the disposition of the bodies *superficies*, as it is more or less apt to reflect light; since, the reflection of light is made from the *superficies* of the seen body, and the variety of its reflection begets variety of colours. But, a *superficies* is more or less apt to reflect light; according to the degrees of its being more or less penetrable by the force of light striking upon it. For, the rays of light, that gain no entrance into a body they are darted upon, must of necessity fly back again from it. But, if light gets entrance and penetrates into the body, it either passes quite through it, or else it is swallow'd up and lost in that body: The former constitutes a diaphanous body, as we have already determin'd; and the semblance which the latter will have, in regard of colour, we have also shew'd must be black.

But, let us proceed a little further. We know that two things render a body penetrable, or easie to admit another body into it; Holes (such as we call pores), and softness or humidity; so that driness, hardness, and compactedness, must be properties

4,  
How the diversity of colours follows out of various degrees of rarity and density.



properties which render a body impenetrable. And accordingly we see, that, if a diaphanous body (which suffers light to run through it) be much compress'd beyond what it was (as, when water is compress'd into ice), it becomes more visible, that is, reflects more light; and consequently, it becomes more white: for, white is that which reflects more light.

On the contrary side, softness, unctuousness, and viscoseness, encreases blackness. As you may experience, in oyling or greasing of Wood which before was but brown; for thereby it becomes more black; by reason that the unctuous parts, added to the other, more easily, then they single, admit into them the light that sticks upon them; and, when it is gotten in, it is so entangled there (as though the wings of it were bird-limed over), that it cannot flie out again. And thus it is evident, how the origine of all colours in bodies is plainly deduced out of the various degrees of rarity and density, variously mixed and compounded.

s.  
Why some bodies are Diaphanous, others Opacous,

Likewise, out of this discourse, the reason is obvious, why some bodies are diaphanous and others are opacous: for since it falls out in the constitution of bodies, that one is composed of greater parts then another; it must needs happen that light be more hindred in passing through a body composed of bigger parts, then another whose parts are less. Neither doth it import that the pores be supposed as great as the parts; for, be they never so large, the corners of the thick parts they belong to must needs break the course of what will not bow, but goes all in straight lines, more then if the parts and pores were both less; since, for so subtile a piercer as light, no pores can be too little to give it entrance. 'Tis true, such great ones would better admit a liquid body into them; such a one as water or air; but the reason of that is, because they will bow and take any ply, to creep into those cavities, if they be large enough; which light will not do.

Therefore 'tis clear, That freedom of passage can happen to light, only there, where there is an extreme great multitude of pores and parts, in a very little quantity or bulk of body (which pores and parts must consequently, be extreme little ones); for, by reason of their multitude, there must be great variety in their situation: from whence it will happen, that many



many lines must be all of pores quite through, and many others all of parts; although the most will be mixed of both pores and parts. And so we see that, although the light pass quite through in many places, yet it reflects from more; not onely in the *superficies*, but in the very body it self of the *Diaphanous* substance. But, in another substance of great parts and pores, there can be but few whole lines of pores, by which the light may pass from the object, to make it be seen; and consequently it must be *Opacous*: which is the contrary of *Diaphanous*, that admits many Rays of Light to passe through it from the *Object* to the Eye; wherby *It* is seen, though the *Diaphanous* hard body intervene between them.

Now, if we consider the generation of these two Colours (White and black) in bodies, we shall find that likewise to justify and second our doctrine. For, white things are generally cold and dry: and therefore are by nature ordain'd to be receptacles and conservers of heat, and of moisture; as Physicians note. Contrariwise, Black, as also green, (which is near of kin to black) are growing colours, and are the die of heat incorporated in abundance of wet; as we see in smoak, in pit-coal, in garden ground, and in Chymical putrefactions, all which are black; as also in young herbs; which are generally green as long as they are young and growing. The other colours, keeping their standing betwixt these, are generated by the mixture of them; and, according as they partake more or less of either of them, are nearer or further off from it.

So that, after all this discourse, we may conclude in short, that The colour of a body is nothing else, but the power which that body hath of reflecting light to the eye, in a certain order and position: and consequently, is nothing else but the very *superficies* of it, with its asperity or smoothness, with its pores or inequalities, with its hardness or softness; and such like. The Rules and limits wherof, if they were duly observ'd and order'd, the whole nature and science of colours would easily be known and described. But, out of this little we have deliver'd of this subject, it may be rightly infer'd, that Real Colours proceed from Rarity and Density (as even now we touch'd), and have their head & spring there: and are not strange

Bb

qualities

6.  
The former doctrine of colours confirm'd by the generation of white and black in bodies.



qualities in the air, but tractable bodies on the earth, as all are, which as yet we have found and medled withal, and are, indeed, the very bodies themselves, causing such effects upon our eye by reflecting of light, which we express by the names of Colours.

## CHAP. XXX.

*Of Luminous or apparent Colours.*

I.  
Apparitions  
of colours  
through a  
Prism, or tri-  
angular-glass,  
are of two  
sorts.

AS for the Luminous Colours, whose natures, Art hath made more maniable by us, than those which are called real Colours, and are permanent in bodies: their generation is clearly to be seen, in the Prism or Triangular glass, we formerly mention'd. The considering of which will confirm our doctrine, That even the colours of bodies are but various mixtures of light and shadows, diversly reflected to our eyes. For the right understanding of them, we are to note, That this glass makes apparitions of colours in two sorts: one, when looking through it there appear various colours in the objects you look on (different from their real ones), according to the position you hold the glass in when you look on them. The other sort is, when the beams of light that pass through the Glass are, as it were, tinged in their passage: and are cast by the Glass upon some solid object, and appear there in such and such colours; which continue still the same, in what position soever you stand to look upon them, either before or behind, or on any side of the Glass.

2.  
The several  
parts of the  
object make  
several angles  
at their en-  
trance into  
the Prism.

Secondly, we are to note, that these colours are generally made by refraction (though sometimes it may happen otherwise, as above we have mention'd). To discover the reason of the first sort of colours that appear by refraction when one looks through the glass; let us suppose two several bodies, one black, the other white, lying close by one another, and in the same horisontal parallel, but so, that that the black be further from us than the white; then, if we hold the Prism, through which we are to see these two oppositely coloured bodies, som-  
what



what above them, and that side of it, at which the coloured bodies must enter into the glass to come to our eye, parallel to those bodies; 'tis evident, That the black will come into the Prism by lesser angles then the white. I mean, that in the line of distance from that face of the glass at which the colours come in, a longer line or part of black will subtend an angle, no bigger then a lesser line or part of white doth subtend.

Thirdly, we are to note, That, from the same point of the object, there come various beams of light to that whole *superficies* of the glass; so that it may, and sometimes doth happen, that from the some part of the object, beams are reflected to the eye from several parts of that *superficies* of the glass at which they enter. And, whenever this happens, the object must necessarily be seen in divers parts; that is, the picture of it will at the same time appear to the eye in divers places. And particularly, we may plainly observe two pictures; one a lively and strong one, the other a faint and dim one. Of which, the dim one will appear nearer us then the lively one, and is caus'd by a secondary ray; or rather, I should say, by a longer ray, that, striking nearer to the hither edge of the glasses *superficies* (which is the furthest from the object), makes a more acute angle then a shorter ray doth, that strikes upon a part of the glass further from our eye, but nearer the object: and therefore, the image made by this secondary or longer ray must appear both nearer and more dusky, then the image made by the primary and shorter ray. And, the further from the object that the glass through which it reflects is situated, (keeping still in the same parallel to the *Horizon*), the further the place where the second dusky picture appears is, from the place where the primary strong picture appears.

If any man have a mind to satisfy himself by experience of the truth of this note, let him place a sheet of white paper upon a black carpet covering a table, so as the paper may reach within two or three fingers of the edge of the capet, (under which, let there be nothing to succeed the black of the carpet, but the empty dusky Ayre); and then let him set himself at a convenient distance, (the measure of which is, that the paper appear at his feet, when he looks through the glass), and

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The reason why sometimes the same object appears through the Prism in two places; and in one place more lively, in the other place more dim.



look at the paper through his Prism, situated in such sort as we have above determin'd: and he will perceive a whitish or lightsome shadow proceed from the lively picture that he sees of white, and shoot out neerer towards him than that lively picture is; and he'll discern that it comes into the glass, through a part of it neerer to his eye or face, and further from the object than the strong Image of the white doth. And further, if he causes the neerer part of the paper to be cover'd with some thin body of a sadder colour; this dim white vanishes: which it doth not if the further part of the paper be cover'd. Wherby it is evident, that it is a secondary image, proceeding from the hither part of the paper.

4  
The reason of  
the various  
colours that  
appear in loo-  
king through  
a Prism.

Now then, to make use of what we have said, towards finding out the reason, why the red, and blew, and other colours appear, when one looks through a Prism: let us proceed upon our former example, in which a white paper lyes upon a black carpet (for, the diametral opposition of those colours makes them most remarkable) so that there be a parcel of black on the hither side of the paper; and therein let us examine, according to our grounds, what colours must appear at both ends of the Paper, looking upon them through the triangular glass.

To begin with the furthest end, where the black lyes beyond the white: we may consider, there must come from the black a secondary dark misty shadow (besides the strong black that appears beyond the paper), which must shoot towards you (in such sort as we said of the whitish lightsome shadow); and consequently, must lye over the strong picture of the white paper. Now in this case, a third midling colour must result, out of the mixture of these two extremes of black and white: since they come to the eye almost in the same line; at least in lines that make so little a difference in their angles, as is not discernable.

The like wherof happens in Cloaths, or Stuffs, or Stockings, that are woven of divers colour'd, but very small threds. For if you stand so far off from such a piece of Stuff, that the little threds of different colours, which lie immediate to one another, may come together as in one line to your eye; it will appear of a midling colour, different from both those it results



results from: But, if you stand so near, that each thred sends Rays enough to your eye, and that the *Basis* of the Triangle, which comes from each Thred to your eye, be long enough to make, at the *vertex* of it (which is in your eye), an angle big enough to be seen singly by it self; then each colour will appear apart, as it truly is.

Now, the various natures of midling colours we may learn of Painters; who compose them upon their Pallets by a like mixture of the extreams. And they tell us that, if a white colour prevail strongly over a dark colour, Reds and Yellows result out of that mixture: but if black prevail strongly over white, then blews, violets, and sea-greens are made. And accordingly, in our case we cannot doubt but that the primary lively picture of the white must prevail over the faint dusky sable mantle, with which it comes mingled to the eye: and doing so, it must needs make a like appearance as the Sun-beams do, when, reflecting from a black cloud, they fringe the edges of it, with Red and with Yellow; and the like they do, looking through a rainy or a windy cloud: and, much like hereto, we shall see this mixture of strong white with a faint shadow of black, make, at this brim of the Paper, a fair ledge of Red; which will end and vanish in a more lightsome one of Yellow.

But at the hither edge of the paper, where the secondary weak picture of white is mingled with the strong black picture, in this mixture the black is prevalent; and accordingly (as we said of the mixture of the Painters colours) there must appear, at the bottom of the paper, a Lumb of deep blew: which will grow more and more lightsome, the higher it grows; and so passing through violet & sea-green, vanish in light, when it reaches to the mastering field of primary whiteness, that sends his stronger Rays by direct lines. And this transposition of the colours, at the several ends of the paper, shews the reason why they appear quite contrary, if you put a black paper upon a white Carpet: And therefore, we need not add any thing particularly concerning that.

And likewise, out of this we may understand why the colours appear quite contrary (that is, Red, where before the blew appear'd, and blew, where Red), if we look upon the same



5.  
The reason  
why the Prism  
in one posi-  
tion, may make  
the colours ap-  
pear quite  
contrary to  
what they did,  
when it was in  
another posi-  
tion.

object through the Glass in another position or situation of it; namely, if we raise it so high, that we must look upwards to see the object: which thereby appears above us; whereas, in the former situation, it came in through the lower *superficies*, and we look'd down to it, and it appear'd under us. For, in this second case, the objects coming into the glass by a *superficies*, not parallel as before, but sloping from the object-wards: it follows, that, the nearer the object is, the lesser must the angle be which it makes with the *superficies*; contrary to what happened in the former case. And likewise, that, if, from one point of the nearer object, there fall two rays upon the glass, the ray that falls uppermost will make a lesser angle, then the other that falls lower: and so, by our former discourse, that point may come to appear in the same place with a point of the further object, and thereby make a midling colour.

So that, in this case, the white which is nearer will mingle his feeble picture with the black that is further off: whereas before, the black that was further off mingled his feeble shadow with the strong picture of the nearer white. Wherefore, by our rule we borrow'd of the Painters, there will now appear a blew on the further end of the paper, where before appeared a red; and by consequence, on the nearer end a red will now appear, where in the former case a blew appear'd. This case we have chosen, as the plainest to shew the nature of such colours; out of which he that is curious may derive his knowledge to other cases; which we omit, because our intent is only to give a general doctrine, and not the particulars of the Science; and rather to take away admiration, than to instruct the Reader in this matter.

6.  
The reason of  
the various co-  
lours in gene-  
ral, by pure  
light passing  
through a  
Prism.

As for the various colours, which are made by straining light through a glass, or through some other *Diaphanous* body; to discover the causes and variety of them, we must examine what things they are that concur to the making of them; and what accidents may arrive to those things, to vary their product. 'Tis clear, that nothing intervenes or concurs to the producing of any of these colours; besides the light it self which is dyed into colour, and the glass or *Diaphanous* body through which it passes. In them therefore, and in nothing else, we are to make our enquiry.

To



To begin then : we may observe, that light, passing through a Prism, and being cast upon a reflecting object, is not alwayes colour ; but in some circumstances it still continues light, and in others it becomes colour. Withal we may observe, that those beams which continue light and endure very little mutation by their passage, making as many refractions, make much greater deflexions from the straight lines by which they came, into the glass, then those Rays do which turn to colour. As you may experience, if you oppose one surface of the Glass Perpendicularly to a Candle, and set a Paper ( not irradiated by the Candle ) opposite to one of the other sides of the Glass : for, upon the paper, you shall see fair light shine without any colour, and you may perceive, that the line, by which the light comes to the Paper, is almost Perpendicular to that line by which the light comes to the Prism. But, when light becomes colour, it strikes very obliquely upon one side of the glass ; and comes likewise very obliquely out of the other, that sends it in colour upon a reflectent body ; so that in conclusion, there is nothing left us whereon to ground the generation of such colours ; besides the littleness of the angle, and the sloapingness of the line, by which the illuminant strikes one side of the Glass and comes out at the other, when colours proceed from such a percussio.

To this then we must wholly apply our selves, and knowing that generally, when light falls upon a body with so great a sloaping or inclination, so much of it as gets through must needs be weak and much diffused ; it follows, that the reason of such colours must necessarily consist in this diffusion and weakness of light ; which the more it is diffused, the weaker it grows, and the more lines of darkness are between the lines of light, and mingle themselves with them.

To confirm this, you may observe, how, just at the egress, from the Prism, of that light, which going on a little further, becomes colours, no colour at all appears upon a paper opposed close to the side of the Glass ; till removing it farther off, the colours begin to shew themselves upon the edges : thereby convincing manifestly, that it was the excess of light, which hindered them from appearing at the first. And, in like manner, if you put a burning glass between the light and the Prism,



so as to multiply the light which goes through the Prism to the paper; you destroy much of the colour, by converting it into light. But on the other side, if you thicken the air, and make it dusky with smoak or dust; you will plainly see, that, where the light comes through a convex glass (perpendicularly opposed to the illuminant), there will appear colours on the edges of the cones that the light makes. And peradventure the whole cones would appear colour'd, if the darkning were conveniently made: for, if an opacous body be set within either of the cones, its sides will appear colour'd, though the air be but moderately thickned; which shews that the addition of a little darkness would make that, which otherwise appears pure light; be thoroughly dyed into Colours. And thus you have the true and adequate cause of the appearance of such colours.

7.  
Upon what  
side every co-  
lour appears,  
this is made  
by pure light  
passing  
through a  
Prism.

Now, to understand what colours, and upon which sides, will appear: we may consider, that, When light passes through a glass or other Diaphanous body, so much of it as shines in the air, or upon some reflecting body bigger then it self, after its passage through the glass, must of necessity have darkness on both sides of it, and so be comprised and limited by two darknesses; but if some opacous body less then the light be put in the way of the light, then it may happen contrariwise, that there be darkness (or the shadow of that opacous body) between two lights.

Again, we must consider, that, when light falls so upon a Prism as to make colours, the two outward Rays, which proceed from the light to the two sides of the *superficies* at which the light enters, are so refracted, that, at their coming out again through the other *superficies*, that Ray which made the less angle with the outward *superficies* of the glass, going in, makes the greater angle with the outside of the other *superficies*, coming out; and contrariwise, that Ray, which made the greater angle, going in, makes the lesser, at its coming out: and the two internal angles, made by those two Rays and the outside of the *superficies* they issue at, are greater then two right angles. And so we see, that the light dilates it self at its coming out.

Now, because Rays that issue through a *superficies*, the nearer they



they are to be perpendiculars to that *superficies*, so much the thicker they are; it follows, that this dilation of light at its coming out of the glass must be made and encrease from that side, where the angle was least at the going in and greatest at the coming out: so that, the nearer to the contrary side you take a part of light, the thinner the light must be there; and contrariwise, the thicker it must be, the nearer it is to the side where the angle at the rays coming out is the greater. Wherefore, the strongest light (that is, the place where the light is least mixed with darkness) must be nearer that side than the other. Consequently hereto, if by an opacous body you make a shadow comprehended within this light; that shadow must also have its strongest part nearer to one of the lights betwixt which it is comprised, then to the other: for, shadow being nothing else but the want of light, hindred by some opacous body; it must of necessity lie averfed from the illuminant, just as the light would have lain if it had not been hindred. Wherefore, seeing that the stronger side of light more impeaches the darkness, then the feebler side doth, the deepest dark must incline to that side where the light is weakest; that is, towards that side on which the shadow appears, in respect of the opacous body or of the illuminant; and so be a cause of deepness of Colour on that side, if it happen to be fringed with colour.

## CHAP. XXXI.

*The causes of certain appearances in luminous Colours; with a Conclusion of the discourse touching the Senses and the Sensible Qualities.*

Of these grounds we are to seek the resolution of all such Symptoms, as appear to us in this kind of colours. First therefore, calling to mind, how we have already declared, that the red colour is made by a greater proportion of light mingled with darkness, and the blew with a less proportion: it must follow, that, when light passes through a glass in such sort as to make colours, the mixture of the light and darkness, on that side where the light is strongest, will encline to a red;

I.  
The reason of each several colour in particular caused by light passing through a Prism.



red; and their mixture on the other side, where the light is weakest, will make a violet or blew. And, this we see fall out accordingly, in the light which is tinged by going through a Prism; for, a red colour appears on that side from which the light dilates or encreases, and a blew is on that side towards which it decreases.

Now, if a dark body be placed within this light, so as to have the light come on both sides of it; we shall see the contrary happen, about the borders of the picture or shadow of the dark body: that is to say, the red colour will be on that side of the picture which is towards or over against the blew colour made by the glass, and the blew of the picture will be on that side which is towards the red made by the glass; as you may experience, if you place a slender opacous body along the Prism, in the way of the light, either before or behind the Prism. The reason wherof is, that the opacous body standing in the middle, environ'd by light, divides it and makes two lights of that which was but one; each of which lights, is comprised between two darkneses; to wit, between each border of Shadow that joyns to each extreme of the light that comes from the glass, and each side of the Opacous bodies shadow. Wherefore in each of these lights, or rather in each of their comixtions with darkness, there must be red on the one side, and blew on the other; according to the course of light which we have explicated.

And thus it falls out, agreeable to the Rule we have given, that blew comes to be on that side of the opacous bodies shadow, on which the glass casts red; and red on that side of it, on which the glass casts blew. Likewise, when light, going through a convex glass makes two cones: the edges of the cone, betwixt the glass & the point of concurrence, will appear red (if the room be dark enough); and the edges of the further cone will appear blew; both for the reason given. For, in this case, the point of concurrence is the strong light betwixt the two cones: of which, that betwixt the glass and the point is the stronger; that, beyond the point, the weaker. And for this very reason, if an opacous body be put in the *axis* of these two cones, both the sides of its picture will be red, if it be held in the first cone which is next to the glass, and both will be blew, if the body be situated  
in



in the further cone : for, both sides being equally situated to the course of the light, within its own cone, there is nothing to vary the colours, but only the strength and weakness of the two lights of the cones on this & that side the point of the concurrence ; which point being, in this case, the strong and clear light, wherof we made general mention in our precedent note, the cone towards the glass and the illuminant is the stronger side, and the cone from the glass is the weaker.

In those cases where this reason is not concern'd, we shall see the victory carried, in the question of colours, by the shady side of the opacous body : that is, the blew colour will still appear on that side of the opacous bodies shadow that is furthest from the illuminant. But, where both causes concur and contest for precedence, there the course of the light carries it: that is to say, the red will be on that side of the opacous bodies shadow where it is thicker and darker, and blew on the other side where the shadow is not so strong; although the shadow be cast that way that the red appears : as is to be seen, when a slender body is placed betwixt the Prism and the reflectant body, upon which the light & colours are cast through the Prism. And 'tis evident, that this cause of the course of the shadow is in it self a weaker cause, than the other of the course of light, and must give way to it whenever they incounter ( as it cannot be expected but that, in all circumstances, shadows should be light ) because the colours which the glass casts in this case, are much more faint and dusky, than in the other.

For effects of this latter cause, we see that, when an opacous body lyes cross the Prism, whiles it stands end-ways, the red or blew colour will appear on the upper or lower side of its picture; according as the illuminant is higher or lower then the transverse opacous body : the blew ever keeping to that side of the picture, that is furthest from the body and the illuminant that make it ; and the red, the contrary. Likewise, if an opacous body be placed out of the *axis*, in either of the cones we have explicated before ; the blew will appear on that side of the picture which is furthest advanced in the way that the shadow is cast, and the red on the contrary. And so, if the opacous body be placed in the first cone, beside the *axis*; the red will appear on that side of the picture, in the *basis* of the second cone, which  
is



is next to the circumference, and the blew on that side next the *axis* : but if it be placed on one side of the *axis* in the second cone ; then the blew will appear on that side the picture is next the circumference, and the red on that side, which is next the center of the *basis* of the cone.

2.  
A difficult  
probleme re-  
solv'd touch-  
ing the Prism.

There remains yet one difficulty of moment to be determined : which is Why, when through a glass two colours (namely, blew and red) are cast from a Candle upon a paper or wall; if you put your eye in the place of one of the colours that shines upon the wall, and so that colour comes to shine upon your eye (so that another man who looks upon it will see that colour plainly upon your eye) nevertheless, you shall see the other colour in the glass? as for example, if on your eye there shines a red, you shall see a blew in the glass; and if a blew shines upon your eye, you shall see a red.

The reason hereof is, that The colours which appear in the glasse are of the nature of those luminous colours we first explicated, that arise from looking upon white and black bordering together. For, a candle standing in the air, is, as it were, a white situated between two blacks; the circumstant dusky air, having the nature of a black : so then, that side of the candle which is seen through the thicker part of the glass appears red, and that which is seen through the thinner appears blew; in the same manner, as when we look through the glass. Whereas the colours shine contrariwise upon a paper or reflecting object; as we have already declared, together with the reasons of both these appearances; each fitted to its proper case of looking through the glass upon the luminous object surrounded with darkness, in the one; and of observing the effect wrought by the same luminous object in some *medium*, or upon some reflectent *superficies*, in the other.

And to confirm this, if a white paper be set standing hollow before the glass, (like half a hollow pillar, whose flats stands edgeways towards the glass, so as both the edges may be seen through it) the further edge will seem blew, and the nearer will be red, and the like will happen, if the paper be held in the free air parallel to the lower *superficies* of the glass, without any black carpet to limit both ends of it (which serves to make the colours the smarter. (So that, in both cases, the air serves mani-  
festly



festly for a black; in the first, between the two white edges, and in the second, limiting the two white ends: and by consequence, the air about the candle must likewise serve for two blacks including the light candle between them.

Several other delightful experiments of luminous colour I might produce; to confirm the grounds I have laid, for the nature and making of them: But, I conceive, these I have mention'd are abundantly enough, for the end I propose to my self. Therefore, I will take my leave of this subtle and nice subject; referring my Reader (if he be curious to entertain himself with a full variety of such shining wonders) to our ingenious Countreyman and my worthy friend, Mr. *Hall*: who, at my last being at *Liege*, shew'd me there most of the experiences I have mention'd, together with several other very fine and remarkable curiosities concerning light; which he promised me he would shortly publish in a work, that he had already cast and almost finished upon that subject. And in it I doubt not but He will give entire satisfaction to all the doubts and Problems that may occur in this subject: whereas my little exercise formerly in making experiments of this kind, and my less conveniency of attempting any now, makes me content my self with thus spinning a course thred (from wooll carded me by others) that may run through the whole doctrine of colours, whose causes have hitherto been so much admired, and that it will do so, I am strongly perswaded; both because, if I look upon the causes which I have assigned *a priori*, me thinks they appear very agreeable to nature and to reason; and if I apply them to the several *Phenomena* which Mr. *Hall* shew'd me, and to as many others as I have otherwise met with, I find they agree exactly with them, and render a full account of them.

And thus, you have the whole nature of luminous colours resolv'd into the mixon of light and darkness; by the due ordering of which, who have skil therein may produce any middle colour he please: as I my self have seen the experience of infinite changes in such sort made; so that it seems to me, nothing can be more manifest, then that luminous colours are generated in the way here deliver'd. Of which how that gentle and obedient Philosophy of Qualities (readily obedient to what hard task soever you assign it) will render a rational account;



account; and what discreet vertue it will give the same things to produce different colours and make different appearances, meerly by such nice changes of situation: I do not well understand. But peradventure, the Patrones of it may say that every such circumstance is a *Conditio sine qua non*: and therewith (no doubt) their Auditors will be much the wiser, in comprehending the particular nature of light, and of the colours that have their origine from it.

3  
Of the Rain-  
bow; and how,  
by the colour  
of any body,  
we may know  
the compositi-  
on of the body  
it self.

The *Rainbow*, for whose sake most men handle this matter of luminous colours, is generated in the first of the two ways we have deliver'd for the production of such colours: and hath its origine from refraction; when the eye, being at a convenient distance from the refracting body, looks upon it to discern what appears in it. The speculation of which may be found in that excellent discourse of *Monsieur des Cartes*, which is the *sixth* of his *Meteors*: where he hath, with great accurateness, deliver'd a most ingenious doctrine of this mystery; had not his bad chance, of missing in a former principle (as I conceive) somewhat obscured it. For, he there gives the cause, so neat and so justly calculated to the appearances, as no man can doubt but that he hath found out the true reason of this wonder of nature, which hath perplex'd so many great wits: as may almost be seen with our very eyes; when, looking upon the fresh dew, in a Sunshiny morning, we may, in due positions, perceive the *Rainbow* colours not three yards distant from us; in which we may distinguish even single drops with their effects. But he, having determined the nature of light to consist in motion, and proceeding consequently, concludes colours to be but certain kinds of motion: by which, I fear, it is impossible that any good account should be given of the experiences we see.

But, what we have already said in that point, I conceive, is sufficient to give the Reader satisfaction therein: and to secure him, that the generation of the colours in the *Rainbow*, as well as all other colours, is reduced to the mingling of light and darkness; which is our principal intent to prove. Adding therto, by way of advertisement, for others whose leisure may permit them to make use thereof; that who shall ballance the proportions of luminous colours may, peradventure, make himself a step to judg of the natures of those bodies, which really



really and constantly wear like dyes : for, the figures of the least parts of such bodies, joyntly with the connexion or mingling of them with pores, must of necessity be that which makes them reflect light to our eyes, in such proportions, as the luminous colours of their tincture and semblance do.

For, two things are to be consider'd in bodies, in order to reflecting of light : either the extancies and cavities of them or their hardness and softness. As for the first, the proportions of light mingled with darkness will be varied, according as the extancies or the cavities exceed, and as each of them is great or small : since cavities have the nature of darkness, in respect of extancies ; as our modern Astronomers shew, when they give an account of the face (as some call it) in the Orbe of the Moon. Likewise, in regard of soft or of resistant parts ; light will be reflected by them more or less strongly, that is, more or less mingled with darkness. For, whereas it rebounds smartly back, if it strikes not upon a hard and a resistant body ; and accordingly will shew it self in a bright colour : it must of necessity not reflect at all, or but very feebly, if it penetrates into a body of much humidity, or loses it self in the pores of it ; and that little which comes so weakly from it, must consequently appear of a dusky die. And, these two being all the causes of the great variety of colours we see in bodies, according to the quality of the body in which the real colour appears, it may easily be determined from which of these it proceeds : and then, by the colour, you may judge of the composition and mixture of the rare and dense parts, which by reflecting light begets it.

In fine, out of all we have hitherto said in this Chapter, we may conclude the Primary intent of our so long discourse: which is, That the Senses of Living Creatures, and the Sensible Qualities in Bodies, are made by the Mixtion of Rarity and Density ; as well as the Natural Qualities we spoke of in their place. For, it cannot be denied but that heat and cold, and the other couples or pairs which beat upon our Touch, are the very same as we see in other bodies ; the qualities which move our Taste and Smell are manifestly a kin and joyn'd with them ; Light we have concluded to be Fire ; and of Motion ( which affects our ear ) ther's no dispute : so that it is evident, how all sensible qualities,

4  
That all the  
Sensible  
Qualities are  
real bodies,  
resulting out  
of several  
mixtures of  
Rarity and  
Density.



qualities are as truly bodies, as those other Qualities which we call natural.

To this we may add, that the Properties of these sensible qualities are such as proceed evidently from Rarity and Density. For (to omit those which our Touch takes notice of, as too plain to be question'd) Physicians, judg and determine the natural qualities of meat and medicines and simples, by their Tastes and Smels. By those qualities they find out powers in them to do material operations; and such as our instruments of cutting, filling, brushing, and the like, do to ruder and grosser bodies: all which vertues being in these instruments by the different tempers of Rarity and Density is a convincing argument, that it must be the same causes, which produce effects of the same kind in their smel and tastes. And, and as for light, 'tis known how corporeally it works upon our eyes.

Again, if we look particularly into the composition of the organs of our Senses, we shall meet with nothing but such qualities, as we find in the composition of all other natural bodies. If we search into our Eye, we shall discover in it nothing but diaphanety, softness, divers colours, and consistencies; which all Anatomists, to explicate, parallel in other bodies: the like is of our Tongue, our Nostrils, and our Ears. As for our Touch, that is so material a sense, and so diffused over the whole body; as we can have no difficulty about it. Seeing then that all the qualities we can discover in the organs of our Senses are made by the various minglings of Rarity with Density; how can we doubt, but that the active powers over these patients must be of the same nature and kind?

Again, seeing that examples above brought convince, That the objects of one sense may be known by another; who can doubt of a community among them, if not of degree, at least of the whole kind? as we see that the Touch is the groundwork of all the rest; and consequently, that being evidently corporeal and consisting in a temper of Rarity & Density, why should we make difficulty in allowing the like of the rest?

Besides, let us compose of Rarity and Density such tempers as we find in our Senses; and let us again compose of Rarity and Density such actors, as we have determined the qualities, we call sensible to be: and will it not manifestly follow, that  
thee



these two, applyed to one another, must produce such effects, as we affirm our Senses have; that is, to pass the outward objects, by different degrees, to an inward receiver?

Again, let us cast our eyes upon the natural resolution of bodies, and how they move us; and we shall thereby discover, both what the Senses are, and why they are just so many, and that they cannot be more. For, an outward body may move us either in its own bulk or quantity; or as it works upon another: The first is done by the Touch; the second by the Ear, when a body, moving the air, makes us take notice of his motion. Now in resolution, there are three active parts proceeding from a body, which have power to move us: the fiery part; which you see works upon your eyes, by the virtue of light: the airy part; which we know moves our nostrils, by being suck'd in with the air. And lastly, the salt; which dissolves in water, and so moves our watry sense, which is, our taste.

5.  
Why the Senses are only Five in number: with a conclusion of all the former doctrine concerning them.

And, these being all the active parts, that shew themselves in the resolution of a body; how can we imagine there should be any more senses to be wrought upon? For, what the stable body shews of it self will be reduced to the touch: what as it moves, to hearing: what the resolutions of it, according to the natures of the resolved atomes that fly abroad, will concern the other three senses; as we have declared. And, more ways of working, or of active parts, we cannot conceive to spring out of the nature of a body.

Finally, if we cast our eyes upon the intention of nature: to what purpose are our Senses, but to bring us into knowledge of the natures of the substances we converse withall? Surely, to effect this, there cannot be invented a better or more reasonable expedient, then to bring to our judgment-seat the likenesses or extracts of those substances; in so delicate a model, that they may not be offensive or cumbersome; like so many patterns presented to us, to know by them what the whole piece is. (For all similitude is a communication between two things, in that quality wherein their likeness consists). And therefore we cannot doubt, but that nature hath given us, by the means we have explicated, an essay to all things in the world that fall under our commerce; whereby we judge whether they be profitable or nocive to us: and yet in so delicate and



subtile a quantity, as may, in no way be offensive to us; whiles we take our measures to attract what is good, and avoid what is noxious.

### CHAP. XXXII.

*Of Sensation, or the motion whereby Sense is properly exercised.*

I.  
*Monsir des Car-*  
*tes his opini-*  
*on touching*  
*Sensation.*

OUT of the considerations which we have delivered in these last Chapters, the Reader may gather the unreasonable-  
ness of vulgar Philosophers; who, to explicate life and sense, are not content to give us terms with out explicating them; but will force us to believe contradictions. Telling us, that Life consisted in this, That the same thing hath a power to work upon it self; and that Sensation is a working of the active part of the same sense upon its passive part: and yet will admit no parts in it; but will have the same indivisible power work upon it self. And this, with such violence and down-bearing of all opposition, that they deem him not considerable in the Schools, who shall offer only to doubt of what they teach him hereabout; but brand him with the censure of one who knows not, and contradicts the very first principles of Philosophy. Wherefore 'tis requisite we should look somewhat more particularly, into the manner how sensation is made:

*Monsir des Cartes*, (who, by his great and Heroick Attempts, and by shewing mankind how to steer and husband their reason to best advantage, hath left us no excuse for being ignorant of any thing worth the knowing), explicating the nature of Sense, is of opinion, that the bodies without us, in certain circumstances, give a blow upon our exterior Organes: from whence, by the continuity of the parts, that blow or motion is continued, till it come to our brain and seat of knowledge; upon which it gives a stroke, answerable to that which the outward sense first received. And there this knock causing a particular effect according to the particular nature of the motion (which depends of the nature of the object that produces it); our soul and mind hath notice, by this means, of every thing



thing that knocks at our gates : and, by the great variety of knocks or motions that our brain feels, ( which rises from as great a variety of natures in the objects that cause them ), we are enabled to judg of the nature and conditions of every thing we converse withal.

As for example ; he conceives Light to be nothing else but a percussio made by the illuminant upon the air, or upon the ethereal substance, which he puts to be mixed with, and to run through all bodies : which being a continue *medium* between the illuminant and our sense, the percussio upon that strikes also our sense ; which he calls the nerve that reaches from the place stricken ( to wit, from the bottom of your eye ) to the brain. Now, by reason of the continuity of this string or nerve, he conceives that the blow, made upon the outward end of it by the *other*, is convey'd by the other end of it to the brain ; the end striking the brain in the same measure as the other struck the other end of it : like the Jack of a Virginal, which strikes the sounding cord, according as the Musicians hand presses upon the stop. The part of the brain which is thus stricken he supposes to be the phantasie ; where he deems the soul resides ; and thereby takes notice of the Motion and Object that are without. And what is said thus of Sight, is to be applyed proportionably to the rest of the Senses.

This then is the summe of *Monsir des Cartes* his opinion ; which he hath very finely expressed, with all the advantages that opposite examples, significant words, and clear method can give to a witty Discourse : Which yet is but a part of the commendations he deserves, for what he hath done on this particular : He is, over and above all this, the first that I have ever met with, who hath published any conceptions of this nature, wherby to make the operations of sense intellegible. Certainly, this praise will ever belong to him, that he hath given the first hint of speaking groundingly, and to the purpose, upon this Subject ; and, whoever shall carry it any further ( as what important Mystery was ever born and perfected at once ? ) must acknowledge to have derived his light from him.

For my part, I shall so far agree with him, as to allow mo-



2.  
The Authors  
opinion tou-  
ching sen'a-  
tion.

tion alone sufficient to work sensation in us: and not only to allow it sufficient, but also to profess, that, not only this, but no other effect whatever can be wrought in us, but motion, and by means of motion. Which is evident out of what we have already deliver'd, speaking of bodies in general, that all action among them either is local motion, or else follows it; and no less evident, out of what we have declared in particular, concerning the operations of the outward senses, and the objects that work upon them: and therefore, whoever shall in this matter require any thing further then a difference of motion, he must first seek other instruments in objects to cause it. For, examining from their very origine the natures, of all the bodies we converse withal; we cannot find any ground to believe they have power or means to work any thing beyond motion.

But, I shall crave leave to differ from him, in determining what is the subject of this motion, wherby the brain judges of the nature of the thing that causes it. He will allow no local change of any thing in a man, further then certain vibrations of strings, which he gives the objects to play upon, from the very sense up to the brain: and, by their different manners of shaking the brain, he will have it know what kind of thing it is that strikes the outward sense; without removing any thing within our body from one place to another. But, I shall go the more common way; and make the Spirits to be the porters of all news to the brain: only adding thereto, that these news, which they carry thither, are material participations of the bodies, that work upon the outward organs of the senses, and, passing through them, mingle themselves with the Spirits, and so go whether they carry them; that is, to the brain, to which, from all parts of the body, they have immediate resort, and a perpetual communication with it.

So that, to exercise Sense (which the *Latines* call *sentire*, but in *English* we have no one word common to our several particular motions of divers perceptions by sense) is, Our brain to receive an impression from the extern object, by the operation or mediation of an organical part made for that purpose, & some one of those which we term an extern Sense; from which impression usually flows some motion proper to the living creature.



ture. And thus you see that the outward Senses are not truly Senses, as if the power of sensation were in them: but in another meaning, to wit, so far as they are instruments of qualifying or conveying the object to the brain.

Now, that the Spirits are the instruments of this conveyance is evident, by what we daily see; that, if a man be very attentive to some one extern object (as, to the hearing or seeing of something that much delights or displeases him), he neither hears or sees any thing but what his mind is bent upon: though, all that while, his eyes and ears be open; and several of their objects be present, which at other times would affect him. For, what can be the reason of this, but that the brain, employing the greatest part of his store of Spirits about that one object, which so powerfully entertains him, the other finde very few free for them to imbue with their Tincture? And therefore they have not strength enough to give the brain a sufficient taste of themselves, to make it be observ'd; nor to bring themselves into a place where they may be distinctly discern'd: but, striving to get to it, they lose themselves in the throng of the others, who for that time besiege the brain closely. Whereas in *Monsir des Cartes* his way, (in which no spirits are required), the apprehension must of necessity be carried precisely according to the force of the motion of the extern object.

This argument, I confess, is not so convincing against his opinion, but that the necessity of the consequence may be avoided; and another reason be given for this effect, in *Monsir des Cartes* his doctrine. For he may say, that the affection, being vehemently bent upon some one object, may cause the motion to be so violent, by the addition of inward percussions, that the other coming from the outward sense, being weaker, may be drown'd by it: as lesser sounds are by greater, which forcibly carry our ears that way, and fill them so entirely that the others cannot get in to be heard, or as the drawing of one man, that pulls backwards, is not felt, when a hundred draw forwards. Yet this is hard to conceive, considering the great eminency which the present object hath over an absent one, to make it self be felt; whence it follows, that multiplication of motion must be extremely encreased within, to overtop

3.  
Reasons to  
perswade the  
Author's opi-  
nion.



and bear down the motion, caused by a present object actually working without.

But, that which indeed convinces me to believe I go not wrong in this course, which I have set down, for extern bodies working upon our sense and knowledge, is first, the convenience and agreeableness to nature, both in the objects and in us, that it should be done in that manner: and next, a difficulty in *Monfir des Cartes* his way, which, me thinks, makes it impossible that his should be true. And then, his being absolutely the best of any I have hitherto met withal, and mine supplying what his falls short in, and being sufficient to perform the effects we see: I shall not think I do amiss in believing my own to be true, till somebody else shew a better.

4.  
Tha. Vital  
Spirits are the  
immediate in-  
struments of  
Sensation, by  
conveying  
sensible quali-  
ties to the  
brain.

Let us examine these considerations one after another. 'Tis manifest, by what we have already establish'd, that there is a perpetual flux of little parts or atomes out of all sensible bodies, that are composed of the four Elements, and are here in the sphere of continual motion by action and passion: and such it is, that, in all probability, these little parts cannot chuse but get in at the doors of our bodies, and mingle themselves with the spirits that are in our nervs. Which if they do, 'tis unavoidable, but that, of necessity, they must make some motion in the brain; as, by the explication we have made of our outward senses, is manifest: and the brain being the source and origine of all such motion in the *Animal*, as is term'd voluntary, this stroke of the object will have the power to cause some variation in its motions that are of that nature, and by consequence, must be a *Sensation*, for, that change, which, being made in the brain by the object, is cause of voluntary motion in the *Animal*, is that we call *sensation*.

But, we shall have best satisfaction, by considering how it fares with every sense in particular. 'Tis plain, that our Touch or feeling is affected by the little bodies of heat, or cold, or the like, which are squee'd or evaporated from the object, and get into our flesh, and consequently, mingle themselves with our spirits: and accordingly, our hand is heated with the flood of subtile fire, which, from a great one without, streams into it; and is benum'd with multitudes of little bodies of cold, that settle in it. All which little bodies, of heat or of  
cold



cold or of what kind soever they be, when they are once got in, must needs mingle themselves with the spirits they meet with in the nerve: and consequently, must go along with them up to the brain. For, the channel of the nerve being so little, that the most accurate Inspectors of nature cannot distinguish any little cavity or hole running along the substance of it; and the spirits which ebb and flow in those channels being so infinitely subtle, and in so small a quantity as such channels can contain: 'tis evident, that an atome of insensible bigness is sufficient to imbue the whole length and quantity of spirit that is in one nerve; and that atome, by reason of the subtilty of the liquor it is immers'd in, is, presently and as it were instantly, diffused through the whole substance of it. The source therefore of that liquor being in the brain, it cannot be doubted, but that the force of the external object must needs affect the brain, according to the quality of the said atome; that is, give a motion or knock, conformable to its own nature.

As for our Taste, 'tis as plain, that the little parts, pressed out of the body which affects it, mingle themselves with the liquor that being in the tongue, is continue to the spirits: and then, by our former argument 'tis evident, they must reach to the brain. And for our Smelling, there is nothing can hinder Odors from having immediate passage up to our brain, when by our nose they are once gotten into our head.

In our Hearing, there is a little more difficulty, for Sound being nothing but a motion of the air which strikes our ear; it may seem more then needs, to send any corporeal substance into the brain: and that it is sufficient, that the vibrations of the outward air, shaking the drum of the Ear, do give a like motion to the air within the ear, that on the inside touches the Tympane; and so this air thus moved shakes and beats upon the brain. But this, I conceive, will not serve the turn; for, if there were no more, but an actual motion, in the making of Hearing, I do not see how sounds could be conserved in the Memory; since, of necessity, motion must always reside in some body: which argument we shall press anon against *Monfir des Cartes* his Opinion for the rest of the Senses.

S.  
How sound is convey'd to the brain by vital spirits.

Out of this difficulty, the very inspection of the parts within the



the ear seems to lead us. For, had there been nothing necessary besides motion, the very striking of the outward air against the *Tympanum* would have been sufficient, without any other particular and extraordinary organization, to have produced Sounds, and to have carried their motions up to the brain: as, we see, the head of a Drum brings the motions of the Earth to our Ear, when we lay it therto; as we have formerly delivered. But, Anatomists find other Tools and Instruments, that seem fit to work and forge bodies withal, which we cannot imagine nature made in vain. There is a Hammer and an Anvile: wherof, the Hammer, striking upon, the Anvile, must of necessity beat off such little parts of the brainy streams, as, flying about, light and stick upon the top of the Anvile. These, by the trembling of the air following its course, cannot miss of being carried up to that part of the brain, wherto the air within the ear is driven by the impulse of the sound; and, as soon as they have given their knock, they rebound back again into the cells of the brain, fitted for harbors to such winged messengers; where they remain lodged with quietness, till they be call'd for again, to renew the effect with the sound made at first. And the various blows which the Hammer strikes, according to the various vibrations of the *Tympanum* (to which the Hammer is fasten'd, and therefore is govern'd by its motions), must needs make great differences of bignesses, and cause great variety of smartnesses of motion in the little bodies they forge.

6.  
How colours  
are convey'd  
to the brain  
by Vital Spi-  
rits.

The last Sense is of Seeing; whose action we cannot doubt is perform'd by the reflection of light to our eye, from the bodies which we see; and this light comes impregnated with a tincture drawn from the *superficies* of the object it is reflected from; that is, it brings along with it several of the little atomes, which of themselves stream, and it cuts from the body it struck upon and rebounds from, and they mingling themselves with the light, in company of it get into the eye, whose fabrick is fit to gather and unite those *species* (as you may see by the Anatomy of it). And from the eye, their journey is but a short one to the brain; in which we cannot suspect they should lose their force: considering how others, that come from organes further off, conserves theirs; and



and likewise considering the nature of the optick spirits, which are conceiv'd to be the most refin'd of all that are in mans body.

Now, that light is mingled with such little atomes, issuing out of the bodies from which it is reflected, appears evidently enough, out of what we have said of the nature and operations of fire and light: and it seems confirm'd, by what I have often observ'd in some chambers where people seldom come; which having their windows to the South, so as the Sun lies upon them a great part of the day in his greatest strength, and their curtains being continually drawn over them, the glass becomes dyed very deep of the same colour the Curtain is of. Which can proceed from no other cause, but that the beams which shoot through the glass, being reflected back from the Curtain, take something along with them from the *superficies* of it: which, being of a more solid corpulence than they, is left behind (as it were in the strainer) when they come to press themselves through passages and pores, too little for it to accompany them in; and so those atomes of colour stick upon the glass, which they cannot penetrate.

Another confirmation of it is, that, in certain positions, the Sun, reflecting from strong colours, will cast that very colour upon some other place; as I have often experienced in lively Scarlet, and cloth of some other smart colours: and this, not in that gloating wise, as it makes colours of pure light, but like a true real dye, and so as the colour will appear the same to a man, wherever he stands.

Having thus shew'd, in all our Senses, the conveniency and agreeableness of our opinion with nature; which hath been deduced out of the nature of the objects, the nature of our spirits, the nature and situation of our nerves, and lastly from the property of our brain: our next consideration shall be, of the difficulty that occurs in *Monsir des Cartes* his opinion. First, we know not how to reconcile the repugnancies appearing in his position of the motion of the *Ether*; especiaclly in light. For, that Ethereal substance, being extreme rare, must perforce be either extreme liquid, or extreme brittle: if the first, it cannot choose but bow and be pressed in foulds, and bodies of unequal motions swimming every where in it; and so 'tis impossible it should bring to the eye any constant apparition of the first mover.

But

7.  
Reasons a-  
gainst *Monsir*  
*des Cartes* his  
opinion.



But, let us suppose there were no such general interruptions every where incountring and disturbing the conveyance of the first simple motion : yet how can we conceive that a push given so far off, in so liquid an element, can continue its force so far ? We see that the greatest thunders and concussions, which at any time happen among us, cannot drive and impart their impulse the ten thousandth part of the vast distance, which the Sun is removed from our eye ; and can we imagine, that a little touch of that luminous body should make an impression upon us, by moving another so extreemly liquid and subtile, as the *Ether* is supposed ; which, like an immense Ocean, tossed with all varieties of motion, lies between it and us ?

But, admit there were no difficulty nor repugnance in the *medium*, to convey to us a stroke made upon it by the Sun's motion : let us at least examine, what kind of motions we must allow in the Sun, to cause this effect. Certainly, it must needs be a motion towards us ; or else it cannot strike and drive the *medium* forward, to make it strike upon us. And if it be so, either the Sun must perpetually be coming nearer and nearer to us ; or else it must ever and anon be receding backwards, as well as moving forwards. Both which are too chymical for so great a wit to conceit.

Now, if the *Ether* be brittle, it must needs reflect upon every rub it meets with in its way ; and must be broken and shiver'd by every body that moves across it : and therefore, must always make an uncertain and most disorderly percussion upon the eye.

Then again ; after it is arrived to the sense, 'tis no ways likely it should be convey'd from thence to the brain ; or that nature intended such a kind of instrument as a nerve, to continue a precise determinate motion. For, if you consider how a Lute string, or, any other such *medium*, conveys a motion made in it ; you will find that, to do it well and clearly, it must be stretch'd throughout to its full extent, with a kind of stiffness : whereas our nerves are not straight, but lie crooked in our body ; and are very lither, till, upon occasion, spirits coming into them swell them out. Besides, they are bound to flesh, and to other parts of the body ; which being cessible, must needs dull the stroke, and not permit it to be carried far. And lastly,



lastly, the nerves are subject to be at every turn contracted and dilated, upon their own account, without any relation to the strokes beating upon them from an extern agent: which is, by no means, a convenient disposition for a body, that is to be the porter of any simple motion; which should always lie watching in great quietness, to observe scrupulously and exactly the errand he is to carry. So that, for my part, I cannot conceive nature intended any such effect, by mediation of the sinews:

But *Monsir des Cartes* endeavours to confirm his opinion, by what uses to fall out in Palsies; when a man looses the strength of moving his hands or other members, nevertheless retains his feeling: which he imputes to the remaining intire of the strings of the nerves, while the spirits are some way defective. To this we may answer, by producing examples of the contrary in some men, who have had the motion of their limbs intire and no ways prejudiced, but no feeling at all quite over their whole case of skin and flesh. As particularly, a servant, in the Colledge of Physitians in *London*; whom the learned *Harvey* (one of his Masters) hath told me was exceeding strong to labour, and very able to carry any necessary burthen, and to remove things dexterously, according to the occasion: and yet he was so void of feeling, that he used to grind his hands against the walls, and against course lumber, when he was employ'd to rummage any; in so much that they would run with blood, through grating of the skin, without his feeling of what occasion'd it.

In our way, the reason of both these conditions of people (the paralytike, and the insensible) is easie to be rendred. For, they proceed out of the diverse disposition of the *animal* spirits in these parts: which if they thicken too much and become very gross, are not capable of transmitting the subtile messengers of the outward world, to the tribunal of the brain, to judge of them; on the other side, if they be too subtile, they neither have, nor give power to swell the skin, and so to draw the muscles to their heads. And surely *Monsir des Cartes* takes the wrong way, in the reason he gives of the Palsie: for, it proceeds out of abundance of humors, which, clogging the nerves, rendreth them washy, and makes them lose their dryness, and become lither; and consequently, unfit and unable, in his

8.  
That the symptome, of the Palsie do no way confirm *Monsir des Cartes* his opinion.



his opinion, for sensation ( which requires stiffness ) as well as for motion.

9.  
That *Monſieur*  
*des Cartes* his  
opinion can-  
not give a  
good account  
how things  
are conserv'd  
in the *Memo-*  
*ry*.

Yet besides all these, one difficulty more remains against this doctrine, more insuperable ( if I mistake not ) then any thing, or altogether we have yet said : which is, how the memory should conserve any thing in it, and represent bodies to us, when our fancy calleth for them ; if nothing but motions come into the brain. For 'tis impossible, that, in so divisible a subject as the Spirits, motion should be conserv'd any long time : as we see evidently in the air ; through which move a flaming Taper never so swiftly, and, as soon as you set it down, almost in the very instant, the flame of it leaves being driven or shaken on one side, and goes quietly and evenly up its ordinary course. Therby shewing, that the motion of the air, which for the time was violent, is all of a sudden quieted and at rest : for otherwise, the flame of the Taper would blaze that way the Air were moved. Assuredly, the bodies, that have power to conserve motion long, must be dry and hard ones, Nor yet can such conserve it very long, after the cause, which made it, ceases from its operation. How then can we imagine, that such a multitude of pure motions, as the memory must be stored withal for the use and service of man, can be kept on foot in his brain, without confusion ; and for so long a time as his memory is able to extend to ? Consider a lesson plaid upon the Lute or Virginals ; and think with your self, what power there is or can be in nature, to conserve this lesson-over continually playing : and reflect, that if the impressions upon the common sense are nothing else but such things, then they must be actually conserved, always actually moving in our heads ; to the end they be immediately produced, whenever it pleases our will to call them.

And if peradventure it should be replied, that 'tis not necessary the motions themselves should always be conserved in actual being ; but 'tis sufficient there be certain causes kept on foot in our heads, which are apt to reduce these motions into act, whenever there is occasion of them : All I shall say hereto is, That this is merly a voluntary Position, and that there appears no ground for these motions to make and constitute such causes ; since we neither meet with any instruments,



ments, nor discover any signs wherby we may be induced to believe or understand any such operation.

It may be urged, that divers sounds are by diseases oftentimes made in our ears, and appearances of colours in our fantasie. But first, these colours and sounds are not artificial ones, and disposed and order'd by choice and judgment: for, no story hath mention'd, that, by a disease, any man ever heard twenty verses of *Virgil*, or an Ode of *Horace* in his ears; or, that ever any man saw fair pictures in his fantasie, by means of a blow givin him upon his eye. And secondly, such colours and sounds, as are objected, are nothing else but (in the first case) the motion of humors in a mans eye, by a blow of upon it; which humours have the virtue of making light, in such sort as we see Sea-water has, when it is clash'd together: and (in the second case) a cold vapour in certain parts of the brain, which causes beatings or motions there; whence proceeds the imitation of sounds: so that these examples nothing advantage that party, thence to infer that the similitudes of objects may be made in the common-sense, without any real bodies reserv'd for that end.

Yet I intend not to exclude Motion from any commerce with the Memory; no more then I have done from Sensation. For, I will not only grant, that all our remembring is perform'd by the means of motion; but also acknowledge, (that in men) it is, for the most part, of nothing else but of motion. For, what are words but motion? And words are the chiefeft objects of our remembrance. 'Tis true, we can, if we will, remember things in their own shapes, as well as by the words that express them; but experience tells us, that, in our familiar conversation, and the ordinary exercise of our memory, we remember and make use of the words, rather then of the things themselves.

Besides, the impressions that are made upon all our other sense, as well as upon our hearing, are likewise for the most part of things in motion: as, if we have occasion to make a conception of a Man or of a Horse, we ordinarily conceive him Walking, or Speaking, or eating, or using some motion in time. And, as these impressions are successively made upon the outward Organs; so are they successively carried into the fantasie, &  
by



by like succession, are deliver'd over into the memory: from whence, when they are call'd back again into the phantasie, they move likewise successively. So that in truth, all our memory will be of motion; or at least, of bodies in motion: yet it is not chiefly of motion, but of the things that are moved, unless it be when we remember words; and how those motions frame bodies which move in the brain, we have already touched.

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CHAP. XXXIII.

*Of Memory.*

I.  
How things  
are conserv'd  
in the Memo-  
ry.

**B**Ut how are these things conserv'd in the brain? And how do they revive in the phantasie the same motions, by which they came in thither at the first? *Monfir des Cartes* hath put us in hope of an explication: and, where I so happy as to have seen that work of his, which the world of learned men so much longs for; I assure my self, I should herein receive great help and furtherance by it. Although with all, I must profess, I cannot understand how it is possible, that any determinate motion should long be preserv'd untainted in the brain; where there must be such a multitude of other motions in the way, to mingle with it, and bring all into confusion. One day I hope this Jewel will be exposed to publique view; both to do the Author right, and to instruct the World.

In the mean time, let us see what our own Principles afford us. We have resolv'd, that Sensation is not a pure driving of the *animal* Spirits, or of some penetrable body in which they swim, against that part of the brain where knowledge resides: but, that it is indeed the driving thither of solid material bodies (exceeding little ones) that come from the Objects themselves. Which position, if it be true, it follows, that these bodies must rebound from thence upon other parts of the brain, where at length they find some vacant Cell, in which they keep their Ranks and Files, in great quiet and order; all such sticking together, and keeping company with one another, that enter'd in together: and there they lye still  
and



and are at rest; till they be stir'd up, either by the natural appetite (which is the ordinary course of Beasts), or by chance, or by the will of the Man in whom they are, upon the occasions he meets with of searching into them. Any of these three Causes raises them up, and gives them the motion that is proper to them; which is the same with that wherby they came in at the first, (for, as *Galileus* teaches us, every body hath a particular motion peculiarly proper to it, when nothing diverts it) and then they slide successively through the phantasie, in the same manner as when they presented themselves to it the first time. After which, if it require them no more, they return gently to their quiet habitation in some other part of the brain; from whence they were call'd and summon'd by the phantasies messengers, the Spirits: but, if it have longer use of them, and would view them better then once passing-through permits; then they are turn'd back again, and lead a new over their course, as often as is requisite; like a Horse, that a Rider paces sundry times along by him that he shews him to, whiles he is attentive to mark every part and motion in him.

But, let us examine a little more particularly, how the Causes we have assign'd raise these bodies that rest in the memory, and bring them to the phantasie. The middlemost of them (namely Chance) needs no looking into, because the principles that govern it are uncertain ones: But the first and the last (which are, the Appetite and the Will) have a power (which we will explicate hereafter) of moving the brain and the nerves depending of it, conveniently and agreeably to their disposition. Out of which it follows, that the little similitudes in the caves of the brain wealing and swimming about, (almost in such sort, as you see in the washing of Currants or of Rice, by the winding about and circular turning of of the Cooks hand), divers sorts of bodies go their courses for a pretty while; so that the most ordinary objects cannot choose but present themselves quickly, because there are many of them, and are every where scatter'd about: but others that are fewer, are longer ere they come in view; much like as in a pair of Beads, that, containing more little ones then great ones, if you pluck to you the string they all hang upon,

2  
How things  
conserv'd in  
the Memory  
are brought  
back into the  
Phantasie.



upon, you shall meet with many more of one sort, then of the other.

Now, as soon as the brain hath lighted on any of those it seeks for, it puts as it were a stop upon the motion of that; or at least, it moves it so, that it goes not far away, and is revocable at will, and seems like a bait to draw into the fantasie others belonging to the same thing, either through similitude of nature, or by their connexion in the impression: and, by this means, hinders other objects, not pertinent to the work the fanſie hath in hand, from offering themselves unseasonably in the multitudes that otherwise they would do. But, if the fanſie should have mistaken one object for another, by reason of some resemblance they have between themselves; then it shakes again the liquid *medium* they all float in, and rouse's every *species* lurking in remotest corners and runs over the whole Beadrout of them: and continues this inquisition and motion, till either it be satisfied with retrieving at length what it required, or that it be grown weary with toſſing about the multitude of little inhabitants in its numerous empire; and so gives over the search, unwillingly and displeasedly.

3.  
A Confirmation  
of the former  
doctrine.

Now, that these things be as we have declared will appear, out of the following considerations. First, we see that things of quite different natures, if they come in together, are remembered together: upon which principle the whole art of memory dependeth. Such things cannot any way be comprised under certain Heads, nor be link'd together by order and consequence, or by any resemblance to one another: and therefore, all their connexion must be, that, as they came in together into the fantasie, so they remain together in the same place in the memory; and their first coupling must proceed from the action, that bound them together in driving them in together.

Next, we may observe, that, when a man seeks and tumbles in his memory for any thing he would retrieve, he hath first some common and confused notion of it; and sometimes he hath a kind of flasking or fading likeness of it, much like as when, in striving to remember a Name, men use to say, it is at their tongues end: and this shews, that he attracts those things he desires and hath use of, by the likeness of something



thing belonging to them. In like manner, when hunger makes one think of meat, or thirst makes one dream of drink, or in other such occasions, wherein the natural appetite stirs objects in the memory and brings them to the fantasie; 'tis manifest, that the spirits informing the brain of the defect and pain which several parts of the body do endure for want of their due nourishment, it gives a motion to the heart, which sends other spirits up to supply the brain, for what service it will order them: by which the brain being fortified, it follows the pursuit of what, the living creature is in want of; till the distemper'd parts be reduced into their due state, by a more solid enjoying of it.

Now, why objects drawn out of the memory use to appear in the fantasie, with all the same circumstances which accompanied them, at the time when the sense sent them thither, (as when, in remembrance of a friend, we consider him in some place, and at a certain time, and doing some determinate action) the reason is, that the same body, being in the same *medium*, must necessarily have the same kind of motion; and so consequently, must make the same impression upon the same subject. The *medium* which these bodies move in (that is, the memory) is a liquid vaporous substance, in which they float and swim at liberty.

Now, in such a kind of *medium*, all the bodies that are of one nature will easily gather together, if nothing disturb them. For as, when a tuned Lute-string is stricken, that string, by communicating a determinate *species* of vibration to the Air round about it, shakes other strings within the compass of the moved air; not all, of what extent soever, but only such, as by their natural motion would cause like curlings and foulds in the Air, as the other doth (according to what *Galileus* hath at large declared) even so, when some atome in the brain is moved, all the rest there about, which are apt to be wafted with a like undulation, must needs be moved in chief; and so they moving, whiles the others of different motions, that, having nothing to raise them, either lie quiet or move very little in respect of the former, 'tis no wonder if they assemble together, and (by the proper course of the brain) meet at the common rendezvous of the fantasie.

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And

4.  
How things  
renew'd in the  
fantasie re-  
turn, with the  
same circum-  
stances they  
had at first.



5.  
How the me-  
mory of things  
past is lost, or  
confounded:  
and how it is  
repair'd again.

And, therefore, the more impressions are made from the same object upon the sense, the more participations of it will be gathered together in the memory; and the stronger impressions it will, upon occasion, make in the fantasie: and themselves will be the stronger to resist any cause that shall strive to deface them. For we see that multitude of objects overwhelms the memory; and puts out, or at least makes unprofitable, those that are seldome thought on. The reason of which is, that they, being little in quantity, because there are but few species of them, can never strike the seat of knowledge, but in company of others; which being more and greater, make the impression follow their nature against the lesser: and in tract of time, things seldome thought of grow to have but a maim'd and confused shape in the memory; and at length are quite forgotten. Which happens, because in the liquid *medium* they are apt to moulder away, if they be not often repair'd: which mouldring and defacing is help'd on by the shocks they receive from other bodies: like as in a Magazin, a thing that were not regarded (but carelessly tumbled up and down to make room for others, and all things were promiscuously thrown upon it) would soon be bruised and crush'd into a mishapen form, and in the end broken all in pieces.

Now, the repairing of any thing in the memory is done, by receiving new impressions from the object: or, in its absence, by thinking strongly of it; which is an assembling and due piecing together of the several particles of bodies, appertaining to the same matter. But, sometimes it happens, that when the right one cannot be found intire, nor all the orderly pieces of it retriv'd with their just correspondence to one another; the fantasie makes up a new one in the place of it: which afterwards, upon presence of the object, appears to have been mistaken; and yet the memory, till then, keeps quietly and unquestion'dly for the true object, what either the thought or chance, mingling several parts, had patch'd up together.

And, from hence, we may discern how the losing or confounding of ones memory may happen; either by sicknesses, that disorder the spirits in the brain & disorder their motions, or by some



some blows on the head, whereby a man is astonied and all things seem to turn round with him. Of all which effects the causes are easie to be found, in these suppositions we have lay'd.

## CHAP. XXXIV.

*Of Voluntary Motion, Natural Faculties, and Passions.*

**H**itherto we have labor'd to convey the Object into the brain : but when it is there, let us see what further effects it causes; and how that action which we call voluntary motion; proceeds from the brain. For the discovery wherof, we are to note, that the Brain is a substance composed of watry parts mingled with earthy ones : which kind of substances we see are usually full of strings; and so, in strong hard Beer, and Vinegar, and other Liquors of the like nature, we see ( if they be exposed to the Sun ) little long flakes, which make an appearance of Worms or Maggats floating about. The reason wherof is, that some dry parts of such Liquors are of themselves as it were hairy or fleasy, that is, have little downy parts ( such as you see upon the legs of Flies, or upon Caterpillars, or in little locks of wool ) by which they easily catch and stick to the other little parts of the like nature, that come near them ; and if the liquor be moved, ( as it is in the boyling of beer, or making of vinegar by the heat of the sun ) they become long strings, because the liquor breakes the ties which are cross to its motion : but such as lie along the stream, or rather the bubbling up, maintain themselves in unity, and peradventure grow stronger, by the winding or folding of the end of one part with another ; and, in their tumbling and rousing still in the same course, the downy hairs are crush'd in, and the body grows long and round, as happens to a lump of dough, or wax, or wool, rould a while in one uniform course. And so, ( coming to our purpose ) we see that the brain, and all that is made of it is stringy ; witness the membranes, the flesh, the bones, &c. But, of all the rest, those called fibers are more stringy ; and the nerves seem to be but an assembly

1.  
Of what matter the brain is composed.



of them: for, though the Nervs be but a great multitude of strings lying in a cluster, nevertheless, by the consent of Physicians and Anatomists, they are held to be of the very substance of the brain, dyed to a firmer consistence, than it is in the head.

This heap of strings (as we may call it) is enclosed in an outside made of membranes; whose frame we need not here display: only we may note, that it is very apt and fit to stretch; &, after stretching, to return again to its own just length. Next, we are to consider, how the brain is of a nature apt to swell and to sink again; even so much that, *Fallopins* reports, it swells according to the encrease of the Moon: which whether it be true or no, there can be no doubt but that it, being of a substance which is full of skins and strings, is capable of being stretch'd and of swelling, upon light occasions, and of falling or sinking again upon as light; as being easily penetrable by vapours and liquors, whose nature it is, to swell and to extend that which they enter into. Out of which it follows, that it must be the nature of the Nerves to do the like; and indeed, so much the more, by how much more dry they are, than the brain: for we see that (to a certain measure) drier things are more capable of extention by the ingression of wet, than moist things are; because these are not capable of receiving much more wet into them.

2.  
What is voluntary motion.

These things being premised, let us imagine that the brain, being first swell'd, afterwards contracts it self; and it must of necessity follow, that, seeing the Nerves are all open towards the brain (though their concavities cannot be discern'd), the spirits and moisture in the brain must needs be press'd into the Nerves: which being already stored with spirits, sufficiently to the proportion of their hard skins, this addition will make them swell and grow hard; as a Balloon doth, which, being competently full of air, hath nevertheless more air press'd into it.

Since therefore, the Masters of Anatomy teach us, that in every muscle there is a nerve, which is spread into a number of little branches along that muscle; it must follow, that, if these little branches be swollen, the flesh likewise of that muscle must also needs be swollen. Now, the muscle having both its ends fastned



fastned, the one in a greater bone, the other in a lesser, and there being least resistance on that part, where the bone is lesser and more movable; the swelling of the muscle cannot choose but draw the little bone towards the great one, and by consequence, move that little bone: and this is that, which Philosophers usually call Voluntary motion. For, since our knowledg remains in the brain, whatever is done by knowledg must be done by the brain: and most of what the brain works for the common service of the living creature proceeds also from knowledg: that is from the motion of fancy, which we have express'd.

This matter being thus far declared, we may now enter upon the explication of certain effects; which peradventure might have challeng'd room in the precedent Chapter, but indeed could not well be handled without first supposing this last discourse: and it is, what is meant by those powers, that are call'd Natural Faculties; which however in their particulars, they be manifold in a living creature, yet, whenever any of them is resolved, it appears to be compounded of some of these five, to wit, the Attractive, the Retentive, the Secretive, the Concoctive, and the Expulsive faculty.

3.  
What those powers are which are call'd Natural Faculties.

Of which, the Attractive, the Secretive, and the Concoctive seem not to belong to the nervs: for though we may conceive that the part of the Animal turns it self towards the thing which it attracts, nevertheless, that very turning seems not to be done by vertue of the muscles and nervs, but rather in a natural way, as the motion of the heart is perform'd; in such sort as we have formerly declared. As for example, if the stomach, when it is greedy of meat, draws it self up towards the throat; it seems rather to be a kind of dryness and wrapping, (such as we see in bladders or leather, either by fire or cold, which make them shrivel up and grow hard), than a true faculty of the living creature to seek after meat.

4.  
How the Attractive and Secretive faculties work.

Nor need we extend our discourse any further about these three faculties: seeing that we have already declared in common, how attraction, drying, and mixture of active bodies with passive ones, is perform'd: which needs but applying to these particulars, to explicate fully their nature. As, for example,



if the Kidneys draw the matter of Urine to them out of the Veinet, it may be by any of the following three manners; to wit, either by draught, by wet, or by steam. For, if the serous parts that are in the blood which runs in the Veins, touch some dry parts conformable to their nature, tending towards the Kidneys; they will infallibly adhere more to those dry parts, than to the rest of the blood. Which if they do in so great a quantity, that they reach to other further parts more dry than these, they will leave the first parts to go to the second: and thus by little, and little, will draw a line of Urine from the blood, if the blood abound with it; and, the nearer it comes to the Kidneys, the stronger still the attraction will be.

The like will happen, if the serosity which is in the blood touch some part wetted with a like serosity; or where such hath lately passed. For, as we see water will run more easily upon a wet part of a board or a stone, than on a dry one: so you cannot doubt, but that, if the serous part which is mix'd with the blood, light upon a current of its own nature, it will stick more to that, than to the current of the blood; and so part from the blood, to go that way which the current of its own nature goes.

Besides, it cannot be doubted, but that, from the Kidneys, and from the passages between the Kidneys and the Veins, in which the blood is convey'd, there arises a steam: whose nature is to incorporate it self with serous matter, out of whose body it hath been extracted. This steam therefore, flying still to the serous blood which passes by, must of necessity precipitate (as I may say) the serous parts of the blood; or rather must filter them out of their main stock: and so will make them run in that current from which it self flows. And thus you see how Attraction and Secretion are made: for, the drawing of the serosity, without drawing the blood, is the parting of the Urine from the blood. And this example, of the Kidneys operation, may be apply'd to the attractions of all the other parts.

5.  
Concerning  
the concoctive  
faculty.

Now, the Concoctive faculty (which is the last of the three we took together) consists of two parts: one is, as it were, a drying of the humour which is to be concocted; the other is



a mingling the substance of the vessel in which the humour is concocted, with the humour it self. For as, if you boyl divers kinds of liquors in brass pans, the pans will taint the liquor with the quality of the brass; and therefore Physicians forbid the use of such, in the boiling of several medicines: so, much more in a living creatures body there can be no doubt, but that the vessel in which any humour is concocted gives a tincture therto. Now, concoction consisting in these two, 'tis evident what the concoctive vertue is; to wit, heat, and the specifical property of vessel which by heat is mingled with the humour.

There remain yet the Retentive and the Expulsive faculties to be discoursed of; wherof one kind is manifestly belonging to the voluntary motion which we have declared: namely, that retention and that expulsion which we ordinarily make of the gross excrements either of meat, or drink, or of other humours, either from our head, or stomach, or Lungs: for, it is manifestly done, partly by taking in of wind, and partly by compressing of some parts and opening of others; as *Galen* shews in his curious book *de usu partium*.

6.  
Concerning  
the Retentive  
and Expulsive  
faculties.

Another kind of Retention and Expulsion, in which we have no sense when it is made, (or if we have, it is of a thing done in us without our will, though peradventure we may voluntarily advance it) is made by the swelling of fibers in certain parts, through the confluence of humours to them (as in our stomach it happens, by the drink and the juice of the meat that is in it): which swelling closes up the passages by which the contained substance should go out (as the moistening of the strings and mouth of a purse almost shuts it); till in some (for example, the stomach after a meal) the humour, being attenuated by little and little, gets out subtilely, and so, leaving less weight in the stomach, the bag, which weighs down lower, than the nearer Orifice at which the digested meat issues, rises a little. And this rising of it is also further'd by the wrinkling up and shortning of the upper part of the stomach; which still returns into its natural corrugation, as the masse of liquid meat leavs soaking it (which it doth by degrees, still, as more and more goes out) and so what remains fills less place,



and reaches not so high in the stomach. And thus at length, the residue and thicker substance of the meat, after the thinnest is got out in steam and the midling part is boil'd over in liquor, comes to presse and gravitate wholly upon the Orifice of the stomach : which being then help'd by the figure and lying of the rest of the stomach, and its strings and mouth relaxing, by having the juice which swell'd them squeez'd out of them ; it opens it self, and gives way to that which lay so heavy upon it to tumble out. In others (for example, in a woman with child) the enclosed substance (retain'd first by such a course of nature as we have set down) breaks it self a passage by force, and opens the orifice at which it is to go out by violence ; when all circumstances are ripe according to nature's institution.

7.  
Concerning  
expulsion  
made by Physick.

But yet there is the expulsion made by Physick, that requires a little declaration. 'Tis of five kinds ; *Vomiting*, *Purging* by Stool, by *Urine*, *Sweating*, and *Salivation* : every one of which seems to consist of two parts ; namely, the Disposition of the Thing to be purged, and the Motion of the Nervs or Fibers for the expulsion. As for example, when the Physician gives a *Purge*, it works two things : one is, to make some certain humour more liquid and purgeable than the rest ; the other is, to make the stomach or belly suck or vent this humour. For the first, the property of the Purge must be, to precipitate that humour out of the rest of the blood ; or, if it be thick, to dissolve it that it may run easily : For the second, it ordinarily heats the stomach, and, by that means, causes it to suck out of the veins ; and so to draw from all parts of the body. Besides this, it ordinarily fills the belly with wind ; which occasions those gripings men feel when they take physick, and is cause of the guts discharging those humours, which otherwise they would retain.

The like of this happens in *Salivation* ; for the humours are by the same means brought to the stomach, and thence sublimed up to be spitten out : as we see in those, who, taking *Mercury* into their body, either in substance or in smoak or by application, do vent cold humours from any part ; the *Mercury* rising from all the body up to the mouth of the patient, as to the helm  
of



of a sublimatory, and the like some say of *Tobacco*.

As for *Vomiting*, it is in a manner wholly the operation of the fibers, provoked by the feeling of some inconvenient body; which makes the stomach wrinkle it self, and work and strive to cast out what offends it.

*Sweating* seems to be caus'd, by the heating of some nitrous body in the stomach: which, being of subtile parts, is by heat dispersed from the middle to the circumference; and carries with it light humours, which turn into water as they come out into the air. And thus you see, in general, and as much as concerns us to declare, what the *Natural Faculties* are: and this, according to *Galen's* own mind, who affirms, that these faculties follow the complexion or temper of parts of a mans body.

Having explicated how Voluntary motion proceeds from the brain: our next work ought to be, to examine what it is that such an object (as we brought, by means of the senses, into the brain from without) contributes, to make the brain apply it self to work such voluntary motion. To which purpose, we will go a step or two back, to meet the object at its entrance into the sense; and from thence accompany it in all its journey and motions onwards. The object which strikes at the senses dore and getting in, mingles it self with the spirits it finds there, is either conform and agreeable to the nature and temper of those spirits, or it is not; that is to say, in short, it is either pleasing or displeasing to the living creature: Or it may be a third kind, which, being neither of these, we may term indifferent. In which sort soever the object affects the sense, the spirits carry it immediately to the brain; unless some distemper, or strong thought, or other accident hinder them.

Now, if the object be of the third kind, that is, be indifferent, as soon as it has stricken the brain, it rebounds to the circle of the memory; and there, being speedily join'd to others of its own nature, it finds them annex'd to some pleasing or displeasing thing, or it doth not: if not, in beasts it serves to little use, and, in men, it remains there till it be call'd for; but if, either in its own nature it be pleasing or displeasing, or afterwards in the memory it be-

came

9.  
How the brain  
is moved to  
work Volun-  
tary motion.



became join'd to some pleasing or annoying fellowship, presently the heart is sensible of it. For, the heart being join'd to the brain by straight and large nervs, full of strong spirits which ascend from the heart; 'tis impossible, but that it must have some communication with those motions, which pass in the brain: upon which the heart (or rather the spirits about it) is either dilated or compressed.

And these motions may be either totally of one kind, or moderated and allay'd by the mixture of its contrary: if of the former sort, one of them we call Joy, the other Grief; which continue about the heart (and peradventure oppress it, if they be in the utmost extremity) without sending any due proportion of spirits to the brain, till they settle a little, and grow more moderate.

Now, when these motions are moderate, they immediately send up some abundance of spirits to the brain; which, if they be in a convenient proportion, are by the brain thrust into such nervs as are fit to receive them: and swelling them, they give motion to the muscles and tendons that are fastned to them; and they move the whole body, or what part of it is under command of those nervs, that are thus fill'd and swell'd with spirits by the brain.

If the object was conformable to the living creature, then the brain sends spirits into such nervs as carry the body to it: but if otherwise, it causes a motion of aversion or flight from it. To the cause of this latter we give the name of Fear: and the other, that carries one to the pursuit of the object, we call Hope, Anger, or Audacity, is mixt of both these; for it seeks to avoid an evil by embracing and overcoming it: and proceeds out of abundance of spirits.

Now, if the proportion of spirits sent from the heart be too great for the brain, it hinders or perverts the due operation, both in man and beast.

9.  
Why pleasing  
objects dilate  
the spirits, and  
displeasing  
ones contract  
them,

All which it will not be amiss to open a little more particularly: and first, why painful or displeasing objects contract the spirits, and grateful ones, contrariwise, dilate them. It is, because the good of the heart consists in use, that is, in heat and moisture; and 'tis the nature of heat to dilate it self in



in moisture; whereas cold and dry things contract the bodies they work on; and such are enemies to the nature of men and beasts. And accordingly, experience, as well as reason, teaches us, that all objects, which be naturally good, are hot and moist, in due proportion to the creature that is affected and pleas'd with them.

Now, the living creature being composed of the same principles, as the world round about him is; and the heart, being an abridgment of the whole sensible creature, and besides full of blood, and that very hot: It comes to pass, that if any of these little extracts of the outward world arrive to the hot blood about the heart, it works in this blood such like an effect, as we see a drop of water falling into a glass of wine, which is presently dispersed into a competent compass of the wine: so that, any little object must needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unless it be so little a one as no effect will follow of it, and then 'tis of that kind, which above we call'd indifferent. If the ensuing effect be connatural to the heart, there rises a motion of a certain fume about the heart, which motion we call Pleasure; and it never fails of accompanying all those motions which are good, as Joy, Love, Hope, and the like: but, if the motion be displeasing, there is likewise a common sense of a heaviness about the heart, which we call *Grief*: and it is common to Sorrow, Fear, Hate, and the like.

Now, 'tis manifest by experience, that these motions are all different ones, and strike against divers of those parts of our body which encompass the heart: out of which striking follows, that the spirits sent from the heart, affect the brain diversly, and are by it convey'd into divers nerves; and so set divers members in action. Whence follows, that certain Members are generally moved, upon the motion of such a passion in the heart; especially in beasts, who have a more determinate course of working, than man hath: and if sometimes we see variety even in beasts, upon knowledge of the circumstances we may easily guess at the causes of that variety. The particularities of all  
which



which motions we remit Physicians and Anatomists: advertising only, that the fume of pleasure, and the heaviness of grief, plainly shew that the first motions participate of Dilatation, and the latter of Compression.

19.  
Concerning  
the Five Sen-  
ses, of what  
Use and End  
they are.

Thus you see, how, by the senses, a living creature becomes judg of what is good, what bad for him: which operation is perform'd more perfectly in Beasts, and especially in those that live in the free air, remote from humane conversation (for their senses are fresh and untainted, as nature made them); than in Men. Yet without doubt nature has been as favourable in this particular, to men, as them; were it not that, with disorder and excess, we corrupt and oppress our senses: as appears evidently by the Story we have recorded of *John of Leige*, as also by the ordinary practice of some *Hermites* in the Deserts; who by their taste or smell, would presently be inform'd whether the herbs, and roots, and fruits they met with, were good or hurtful for them, though they never before had had trial of them.

Of which excellency of the Senses, there remains in us only some dim sparks, in those qualities which we call *sympathies* and *antipathies*; wherof the reasonss are plain, out of our late discourse: and are nothing else, but a conformity or opposition of a living creature, by some individual property of it, to some body without it; in such sort as its conformity or opposition to things by its specifical qualities is term'd natural, or against nature. But of this we shall discourse more at large hereafter.

Thus it appears, how the senses are seated in us, principally for the end of moving us to or from objects, that are good for, or hurtful to us. But, though our Reader be content to allow this intent of nature, in our three inferiour senses; yet he may peradventure not be satisfied, how the two more noble ones (the **Hearing** and the **Seeing**) cause such motions to or from objects, as are requisite to be in living creatures for the preservation of them: for (may he say) how can a man, by only seeing an object, or by hearing the sound of it, tell what qualities it is imbued with? or, what motion of liking or disliking, can be caus'd in his heart, by his meer receiving the visi-  
ble



ble *species* of an object at his eyes, or by his ears hearing some noise it makes? And, if there be no such motion there, what should occasion him to prosecute or avoid that object? When he tastes, or smells, or touches a thing, he finds it sweet, or bitter, or stinking, or hot, or cold; and is therewith either pleased or displeased: but, when he only sees or hears it, what liking or disliking can he have of it, in order to the preservation of his nature.

The solution of this difficulty may in part appear, out of what we have already said. But, for the most part, the objects of these two nobler senses move us, by being joyn'd in the Memory with some other thing, that either pleas'd or displeas'd some of the other three senses. And from thence it is, that the motion of going to imbrace the object, or aversion from it, immediately proceeds. As, when a dog sees a man that uses to give him meat, the *species* of the man coming into his fanſie calls out of his memory the others which are of the same nature, and are former participations of that man, as well as this fresh one is: but, these are joyn'd with *species* of meat, because at other times they did use to come in together; and therefore, the meat being a good unto him, and causing him (in the manner we have said) to move towards it, it will follow that the dog will presently move towards that man, and express a contentedness in being with him. And this is the ground of all affluetion in beasts, and of making them capable of receiving any instructions.

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#### C H A P. XXXV.

*Of the material instruments of Knowledge and Passion: Of the several effects of Passions: Of Pain and Pleasure, and how the vital spirits are sent from the brain into the intended parts of the body, without mistaking their way.*

**T**O conclude this great business, which concerns all the mutations and motions that are made by outward Agents in a living creature, it will not be amiss to take a short and general survey, of the material instruments which concur

I.  
That *Septum*  
*Lucidum* is the  
seat of the fan-  
ſie.



concur to this effect. Wherof the brain being principal, or at least, the first and next of the principals; we may take notice that it contains, towards the middle of its substance, four concavities, as some count them: but in truth, these four are but one great concavity, in which four, as it were, divers rooms may be distinguished. The nether part of these concavities is very unequal, having joyn'd to it a kind of a net, wrought by the entangling of certain little arteries, and of small emanations from a Sinus, which are interwoven together. Besides this, it is full of kernels, which make it yet more uneven.

Now, two rooms of this great concavity are divided by a little body, somewhat like a skin, (though more fryable) which of it self is clear; but there it is somewhat dim'd, by reason that, hanging a little slack, it somewhat shrivels together: and this, Anatomists call, *Septum lucidum*, or *speculum*; and 'tis a different body from all the rest that are in the brain. This transparent body hangs as it were straightwards, from the forehead towards the hinder part of the head: and divides the hollow of the brain, as far as it reaches, into the right and the left ventricles.

This part seems to me, (after weighing all circumstances and considering all the conveniencies and fitnesses) to be that, and only that, in which the fanſie or common ſenſe reſides: though *Monſir des Cartes* has rather choſen a kernel to place it in. The reaſons of my aſſertions are; Firſt, that it is in the middle of the brain, which is the moſt convenient ſituation to receive the meſſages from all our body, that come by nervs, ſome from before, and ſome from behind. Secondly, that, with its two ſides, it ſeems conveniently oppoſed to all ſuch of our ſenſes, as are double; the one of them ſending its little meſſengers or atomes, to give it advertiſements on one ſide, the other on the other ſide: ſo that it is capable of receiving impreſſion indifferently from both. Again, by the nature of the body, it ſeems more fit to receive all differences of motion, than any other body near it. It is alſo moſt conformable to the nature of the eye; which, being our principal outward ſenſe, muſt needs be in the next degree to that, which is elevated a ſtrain above our outward ſenſes. Fifthly, it is of a ſingular and peculiar nature; wheras the kernels are many, and all of them of the ſame  
con-



condition, quality, and appearance. Sixthly, it is seated in the very hollow of the brain: which of necessity must be the place and receptacle, where the *specieses* and similitudes of things reside; and where they are moved and tumbled up and down, when we think of many things. And lastly, the situation we put our head in, when we think earnestly of any thing, favours this opinion: for then we hang our head forwards, as it were forcing the *specieses* to settle towards our forehead; that from thence they may rebound, and work upon this diaphanous substance.

This then supposed, let us consider, that the atomes or likenesses of bodies, having given their touch upon this Septum or Speculum, do thence retire back into the concavities, and stick (as by chance it happens) in some of the inequalities they encounter with there. But, if some wind or forcible steam should break into these caves, and as it were brush and sweep them over; it must follow, that these little bodies will loosen themselves, and begin to play in the vapour which fills this hollow place: and so, flitting up and down, come anew to strike and work upon the Speculum or fantasy. Which being also a soluble body, many times these atomes, striking on it, carry some little corporal substance from it sticking upon them: whence ensues, that they, returning again with those tinctures or participations of the very substance of the fantasy, make us remember, not only the objects themselves, but also that we have thought of them before.

Further, we are to know, that all the nervs of the brain have their beginnings not far from this speculum: of which we shall more particularly consider two, that are call'd the sixth pair or couple; which pair has this singularity, that it begins in a great many little branches, that presently grow together and make two great ones contain'd within oae skin. Now this being the property of a sense (which requires to have many fibers in it; that it may be easily and vigorously stricken, by many parts of the object lighting upon many parts of those little fibers): it gives us to understand, that this sixth couple hath a particular nature, conformable to the nature of an extern sense; and that the Architect who placed it there intended, by the several conduits of it, to give notice to some part they go to, of what passes in the brain. And accordingly

2.  
What causes us to remember, not only the object itself, but also that we have thought of it before.

3  
How the motions of the fantasie are derived to the heart.



dingly one branch of this nerve reaches to the heart ; not only to the *Pericardium*, as *Galen* thought, but even to the very substance of the heart it self, as later Anatomists have discover'd : by which we plainly see how the motion, which the senses make in the *Speculum*, may be derived down to the heart.

4.  
Of Pain and  
Pleasure.

Now therefore let us consider, what effects the motions so convey'd from the brain will work in the heart. First, remembering how all that moves the heart is either pain or pleasure (though we do not use to call it pain, but grief, when the evil of sense moves us only by memory, and not by being actually in the sense) ; and then calling to mind, how pain (as Naturalists teach us) consists in some division of a nerve, (which they call *Solutio continui* ; and must be in a nerve, for that no solution can be the cause of pain without sense, nor sense be without nerves) : we may conclude, that the effect which we call pain, is nothing else but a compression. For, although this solution of continuity may seem to be a dilatation, yet in truth, it is a compression in the part where the evil is : which happens to it in the same manner as we shew'd (when we spoke of the motion of *Restitution*) it doth to stiff bodies, that by violence are compress'd and drawn into a lesse capacious figure, than their nature affects ; and return into their own state, as soon as the marring violence leaves them at liberty.

Pleasure, therefore, must be contrary to this, and consist in a moderate dilatation : for, an immoderate one would cause a compression in some adherent parts ; and there would become pain. And conformable to this, we experience, that generally they are hard things which breed pain to us, and those which breed pleasure are oily and soft ; as meats and odours, which are sweet to the taste and smell, and soft substances, which are grateful to the touch : the excess of all which proves offensive and painful ; so that, from the extremity of pleasure, one enters presently upon the confines of pain.

Now then let us consider, how the little similitudes of bodies, which from without come into the fantasy, must of necessity work there, according to their little power, effects pro-



proportionable to what they wrought first in the outward senses, from whence they were convey'd to the brain. For, the senses (that is the nervs) and the *Septum lucidum*, having both of them their origin from the very substance of the brain, and differing only in degrees of purity and refinement; the same object must needs work like effects in both, compressing or dilating them proportionably to one another. Which compression or dilatation is not pain or pleasure, as it is in the outward sense; but as it is reported to the heart: and that, being the seat of all pains or pleasures wrought in other parts, and that (as it were) dies them into those qualities, is not capable of feeling either it self; so that the strokes of any little similitudes upon the fantasie make only compressions or dilatations there, not pains or pleasures.

Now these bodies or similitudes, if they be reverberated from the fantasie or *Septum Lucidum* upon the little roots of the nervs of the fixt couple, which go to the heart, must needs work there a proportionable impression to what they wrought upon the fantasie, either compressing or dilating it; and the heart being extremely passive, by reason of its exceeding tenderness and heat, cannot choose but change its motion, at least in part, if not in whole: and this with relation to two causes; one the disposition of the heart it self, the other, the vehemency of the stroke.

This change of motion and different beating of the heart is that which properly is called *Passion*; and is ever accompanied with pleasure or with grief; according to the nature of the impression, that either contracts or dilates the heart and the spirits about it: and is discovered by the beating of the arteries and of the pulse, Conformable wherunto, Physicians tell us, that every passion hath a distinct pulse.

The pulses are divided in common, by abundance, or by want of spirits; yet in both kinds, they may have common differences: for in abundance, the pulse may be quick or slow, regular or irregular, equal or unequal; and the like may happen in defect of spirits, according to the motions of the heart which are their causes. Again, the object, by being present or further off, makes the stroke greater or lesser, and accordingly, varies the motion of the heart.

Let us then call to mind, how we have formerly declared,

E e

that

<sup>5.</sup>  
Of Passion.

<sup>6.</sup>  
Of several  
Pulses caused  
by Passion.



that life consists in heat and humidity ; and that these two join'd together make a thing great : and we may conclude that, of necessity, the motion which is most lively must have a great, full, and large stroke, like the even rolling waves of a wide and smooth sea ; and not too quick or smart, like the breaches of a narrow Fretum, agitated by tempestuous winds. From this other motions may vary, either by excess, or by deficiency : the first makes the stroke become smart, violent, and thick ; the other slackens it, and makes it grow little, slow, weak, and thin, or seldom.

And if we look into the motions of our heart, we shall see these three differences of them follow three several chief passions. The first follows the passion of Joy ; the second, the passion of Anger ; and the third, the passion of Grief. Nor need we look any further into the causes of the several motions ; for we see that Joy and Grief, following the stroke of sense, the one of them must consist in an oily dilatation, that is, the spirits about the heart must be dilated by a gentle, large, great, and sweet motion, in a moderation between velocity and slowness : the other contrariwise (following the stroke of sense in pain, as the first did in pleasure) must contract the spirits ; and consequently, make their motion or stroke become little, and deficient from all the properties we have above set down.

As for Anger, the motion following that passion is, when the abundance of spirits in the heart is a little check'd by the contrary stroke of sense, but presently overcomes that opposition : and then, as we see a hinder'd water, or a man, that suddenly or forcibly brake through what withstood their motion, go on with a greater violence than they did, and as it were precipitately ; so the heart, having overcome the contraction, which the sense made in it, dilates it self with a fury, and makes its motion smart and vehement. Whence also it follows, that the spirits grow hotter than they were : and accordingly, it is often seen, that, in the scoulding of a woman, and in the irritation of a dog, if ever now and then one thwart them and interpose a little opposition, their fury will be so sharpned and heightened, that the woman will be transported beyond all limits of reason, and the dog will be made mad, with nothing else done to him, but angring him at convenient times : and  
some



some men likewise have, by slight oppositions iterated speedily upon them, before their spirits could relent their vehement motion (and therefore, must still encrease it, ), been engaged into feavors.

This passion of Anger seems almost to be solitary, on the side of excess beyond joy (which is, as it were the standard and perfection of all passions; as light or whiteness is of all colours): but on the other side, of deficiency, there are several middle passions, which participate more or less of joy and grief. As, particularly, those two famous ones, which govern mans life, Hope and Fear. Concerning which Physicians tell us, that the pulse or beating of Fear is quick, hard, and unequal: to which I conceive we may safely add, that it must also be small and feeble; the perfection of joy decreasing in it on one side, to wit, from greatness and largeness, but not intirely, so that a kind of quickness supplies in part the other defect. Hope, on the other side, is in such sort defective from joy, that nevertheless it hath a kind of constancy, and moderate quantity, and regularity in its motion: and therefore is accounted to be the least hurtful of all the passions, and that which more prolongs mans life. And thus you see how those motions, which we call passions, are engender'd in the heart: and what they are.

Let us then in the next place consider, what will follow in the rest of the body, out of these varieties of Passions, once rais'd in the heart, and sent into the brain. 'Tis evident, that, according to the nature and quality of these motions, the heart must needs in every one of them void, out of it self into the arteries, a greater or lesser quantity of blood; and that in divers fashions; and the arteries, which lie fittest to receive these sudden ejections of blood, are those which go into the brain: which course being directly upwards, we cannot doubt, but that it is the hottest and subtlest part of the blood, and the fullest of spirits, that flies that way. These spirits then running a long and perplexed journey up and down in the brain, by various meanders and anfractuolities, are there mingled with the humid steam of the brain it self, and therewith cooled; and come at last to smooke at liberty in the hollow ventricles of the brain, by reeking out of the little arterial branches, that weave the *plexus choroides* or net we spoke of erewhile: and they

7.  
Of several other effects caused naturally in the body by passions.



they, being now grown heavy, fall (by their natural course) into that part or process of the brain, which is called *medulla spinalis*, or the marrow of the back-bone; which, being beset by the nervs that run through the body, it cannot happen otherwise, but that these thick'ned and descending spirits must either fall themselves into those nervs, or else press into them other spirits which are before them, that, without such new force to drive them violently forwards, would have slid down more leisurely. Now, this motion being downwards, and meeting with no obstacle, till it arrive to its utmost period that way; the lowest nervs are those, which naturally feel the communication of these spirits first.

But, 'tis true, if the flowing tide of them be great, and plentiful, all the other nerves will also be so suddenly fill'd upon the filling of the lowermost, that the succession of their swellings, will hardly be perceptible: as a sudden and violent inundation of water seems to rise on the sides of the channel, as it doth at the Mill-dam; though reason assures us, it must begin there, because there it is first stop't.

On the contrary side, if the spirits be few, they may be in such a proportion, as to fill only the lower nervs, and to communicate little of themselves to any of the others. And this is the case in the passion of fear: which being stored with fewer spirits, than any other passion that causes a motion in the body, it moves the leggs most; and so carries the animal, that is afraid, with violence from the object that affrights him. Although, in truth, it is a faint hope of escaping, mingled with fear, which begets this motion: for, when fear is single, and at its height, it stops all motion by contracting the spirits, and thence is called Stupor; as well as grief, for the same reason. And accordingly we see extreme cowards, in the extremity of their fear, have not the courage to run away no more than to defend or help themselves by any other motions.

But, if there be more abundance of spirits, then the upper parts are also moved, as well as the leggs; whose motion contributes to defence: but the brain it self and the senses which are in the head, being the first in the course of this flood of spirits that is sent from the heart to the head, 'tis impossible but that some part of them should be press'd into the nervs of those senses;



senses; and so will make the animal vigilant and attentive to the cause of its fear or grief.

But, if the fear be so great, that it contracts all the spirits and quite hinders their motion (as in the case we touch'd above), then it leaves also the nervs of the senses destitute of spirits; and so, by too strong apprehension of a danger, the animal neither sees nor apprehends it: but as easily precipitates it self into it, as it happens to avoid it, being meerly govern'd by chance; and may peradventure seem valiant through extremity of fear.

And thus you see, in common, how all the natural operations of the body follow, by natural consequence, out of the passions of the mind: without needing to attribute discourse or reason, either to men or beasts, to perform them. Although, at first sight, some of them may appear, to those that look not into their principles and true causes, to flow from a source of intelligence: whereas 'tis evident, by what we have laid open, they all proceed from the due ranging and ordering of quantitative parts, so or so proportioned by rarity and density. And there is no doubt, but, who would follow this search deeply, might certainly retrieve the reasons of all those external motions, which we see, use to accompany the several passions in Men and Beasts. But, for our intent, we have said enough; to shew by what kind of order and course of nature they may be effected (without confining our selves over scrupulously to every circumstance that we have touch'd); and to give a hint, whereby others, that will make this inquiry their task, may compile an intire and well grounded and intelligible doctrine of this matter.

Only we will add one advertisment more; which is, that these external motions, caused by passion, are of two kinds: for, some of them are, as it were, the beginnings of the actions, which nature intends to have follow out of the passions that cause them; but others are only bare signs of passions that produce them, and are made by the connexion of parts, unnecessary for the main action that is to follow out of the passion, with other parts that by the passion are necessarily moved. As for example, when an hungry mans mouth waters at the sight of good meat, it is a kind of beginning of eating, or of prepa-



sation for eating ; for, when we eat, nature draws a moisture into our mouth, to humectate our meat and convey the tast of it into the nervs of the tongue, which are to make report of it to the brain : but, when we laugh, the motion of our face aims at no further end ; and follows only by the connexion of those muscles, which draw the face in such a sort, to some inward parts, that are moved by the passion out of which laughing proceeds.

8.  
Of the *Diaphragma*.

But, we must not leave this subject without some mention of the *Diaphragma* ; into which the other branch of those nervs, that are call'd of the sixth conjugation, comes : for, the first branch we have said goes into the heart, and carries thither the objects that come into the brain ; and this, we shall find, carries back to the brain the passion or motion, which by the object is rais'd in the heart. Concerning this part of our body, you are to note, that it is a musculous membrane, which in the middle of it hath a sinewy circle ; wherto is fastned the case of the heart, call'd the *Pericardium*. This *Diaphragma* is very sensible, receiving its vertue of feeling from the above mention'd branch of the sixth couple of nervs ; and, being of a trembling nature, is, by our respiration, kept in continual motion : and flaps, upon all occasions ; as a drum head would do, if it were slack and moist, or as a sail would do, that were brought into the wind.

Out of this description of it, 'tis obvious to conceive, that all the changes of motion in the heart must needs be express'd in the *Diaphragma*. For, the heart beating upon the *Pericardium*, and the *Pericardium* being join'd to the *Diaphragma* ; such jogs and vibrations must needs be imprinted and echoed there, as are formed in the heart : which, from thence, cannot chuse but be carried to the brain, by the sixth couple of nervs. And thus it comes about, that we feel and have sensation of all the passions, that are moved in our heart. Which peradventure is the reason, why the Greeks call this part *σπέρη*, and from it derive the verb *σπρονέιν*, that in Latine signifies *Sapere*, with Us, to Savour or to like ; for, by this part of our body, we have a liking of any object, or a motion or inclination towards it : from whence *σασπρονέιν* is derived, by composition of *σπρονέιν* with *σάϑ* ; for a prudent man is he, that likes and is moved



moved to compass wholesom and good things. Which Etymology of the word seems to me more natural, than from the phrensy, from whence some derive it; because a great distemper or inflammation in the *Diaphragma* often causes that disease.

Now, because the object is convey'd from the brain to the heart some part of its way, by the same passage as the motion of the heart is re-convey'd back to the brain: it must of necessity follow, that who is more attentive to outward sense, less considers or reflects on his passion; and who is more attentive to observe and be govern'd by what passes in his heart, is less wrought upon by external things. For, if his fantasy draws strongly to it, the emanations from outward agents upon the senses; the stream of those emanations will descend so strongly from the overflow'd fantasy into the heart, that it will hinder the ascent of any fewer and weaker spirits by the same pipe: But, if the current set strongest upwards, from the heart by the *Diaphragma* to the brain; then, it will so fill the pipe by which it ascends, that little of a weaker tide can make a contrary eddy water in the same channel.

And, by this means nature effects a second pleasure or pain in a living creature, which moves it (oftentimes very powerfully) in absence of the primary object: as we may observe, when, thinking of any pleasing or displeasing action, we find about our heart a motion which entices us to it, or averts us from it. For, as the first pleasure was occasioned, by the stroke which the object, apply'd to the outward sense, made upon the fantasy, (which can judg of nothing without being stricken by it): so, the second pleasure springs from the spirits moved in the heart, by messengers from the brain; which by the *Diaphragma* rebound a stroke back again upon the fantasy. And, from hence it proceeds, that Memory delights or afflicts us: and that we think of past things with sweetness or with remorse: and thereby assuefaction is wrought in beasts, as far as the appetitive part contributes thereto; to perfect what was begun in their cognoscitive part, by the ingression of corporeal *specieses* into their fantasy, in order to the same effect, as we have touch'd before.

But now let us examine, how so small a quantity of a body, as comes from an object into our sense, can be the cause of so great

9.  
Concerning  
pain and pleasure  
caused by  
the memory of  
things past.

10.  
How so small  
bodies, as atoms  
are, can  
cause so great  
motions in the  
a heart,



a motion about our heart. To which purpose we are to remember, that this motion is perform'd in the most subtile and thin substance, that can be imagin'd. They are the vital spirits that do all this work ; which are so subtile, so agil, and so hot, that they may in some sort be termed fire. Now, if we reflect how violent fire is ; we need not wonder at the suddain and great motion of these passions.

But we must further take notice, that they are not in the greatest excess, but where the living creature hath been long inured and exercised to them, either directly or indirectly : so that they arrive not to that pitch so much out of the power of the agent, as out of the preparation and disposition of the patient. As when cold water hath been often heated by extinguishing red hot irons in it ; after some repetitions, a few quenchings will reduce it from cold to boiling, that at the first would scarce have made it lukewarm : and accordingly we see a heart, that for a long time hath loved and vehemently desired enjoying, is transported in a high degree, at the least sight and renuance of strokes from its beloved object ; and is as much dejected, upon any the least deprivation of it. For, to such an object the living creature is hurried away, by a force much resembling the gravity or celerity of a dense body, that is set on running down a steep hill ; to which, the only taking away of a weak let or the least stop gives a precipitate course, not out of the force of what is done to it, but out of the force which was formerly in the thing, though for the present it lay there undiscovered : and so likewise in these cases, the object rather gives the occasion of the violent motion, than the force or power to it.

How the vital  
spirits, sent  
from the brain,  
run to the in-  
tended part of  
the body,  
without mis-  
take.

These things being thus determined, some peradventure may ask, how it comes to pass that the spirits, which cause motion, being sent on their errand by the brain, alwayes hit the right way ; and light duly into those very sinews, which move the living creature according as is requisite for its nature ? Since all the passages are open, what is it that governs them, so as they never mistake ; and the animal is never driven towards harm, in stead of flying from it ? Who is their guide in these obscure paths ? But, it were to impute ignorance to the Maker, to think that he framed all the passages alike ; and so every one of them



them promiscuously apt to receive into them all sorts of spirits, however they be moved. And therefore, we may assure our selves that since, in these diversities of occasions, there are likewise divers kinds of motions from the heart; either there is, proportionable to them, divers kinds of passages fit to receive and entertain the spirits, according to the condition they are in (so as the passages, which are ajusted to one kind of spirits, will not admit any of another nature) : or else, the first motions of liking or disliking in the heart, which (as we have said) cause a swelling or a contradiction of it against this or that part, stops and hinders the entrance of the spirits into some sinews, and opens others, and drives the spirits into them; so as, in the end by a result of a chain of swellings and contractions of several parts successively one against another, the due motions of prosecution or averision are brought about.

As, for example, an object that affects the heart with liking, by dilating the spirits about the heart, sends some into the optick nervs, and makes the living creature turn his eye towards it, and keep it steady upon what he desires : as contrariwise, if he dislike and fear it, he naturally turns his eye and head from it. Now, of this motion of the eye and head may depend the running to the thing, in one case, and the running from it, in the other : for, the turning of the neck one way may open a passage for the spirits into those sinews which carry the rest of the body towards the object ; and the turning of it to the other side may open other sinews, which shall work a contrary effect, and carry the animal from the object. And the moving of those sinews, which at first turn the neck, proceeds from the quality and number of the spirits that ascend from the heart, and from the region of the heart whence they are sent : according to the variety wherof, there are divers sinews fitted to receive them.

To make up which discourse, we call to mind, what we have said a little above; concerning the motions caused in the external parts of the body, by passion moving within: as when Fear mingled with hope gives a motion to the legs. Anger to the arms and hands, and all the rest of the body, as well as to the legs, & all of them, an attention in the outward senses; which nevertheless perverts every one of their functions, if the passion be in extremity.

And



And then surely we may satisfy our selves, that either this, or some way like it, ( which I leave to the curious in Anatomy to settle with exactness; for 'tis enough for my intent, to shew in gross, how these operations may be done, without calling in some incomprehensible qualities to our aid ) is the course of nature in motions, where no other cause intervenes besides the object working upon the sense: which all the while it doth, it is the office of the eye of fantasie (or common sense) to lie ever open; still watching to observe what warnings the outward senses send to him, that accordingly he may direct and change the motions of the heart and whole body.

11.  
How men are  
blinded by  
passion.

But, if the object make violent impressions upon the sense, and the heart, being then vehemently moved, thereupon send abundance of spirits up to the brain; this multitude of spirits, thronging upon the common sense, oppresses it (as we have already said) in such sort, that the notice which the sense gives of particular circumstances cannot prevail to any effect in the brain: and thus, by the misguidance of the heart, the work of nature is disordered. Which when it happens, we express in short, by saying that Passion blinds the creature, in whom such violent and disorderly motions have course: for Passion is nothing else, but a Motion of the Blood and Spirits about the Heart; and is the preparation or beginning of the Animals working, as we have above particularly display'd.

And thus you see in common, how the circuit is made from the Object to the Sense, and from it, by the Common sense and Fantasie, to the Heart, and from the heart back again to the brain; which then sets on work those Organs or parts the animal is to make use of in that occasion; and they either bring him to, or carry him from the object, that at the first caused all this motion, and in the end becomes the period of it.



## CHAP. XXXVI.

*Of some actions of Beasts, that seem formal acts of reason;  
as doubting, resolving, inventing.*

**I**N the last Chapter the foundations are laid, and the way is opened for discovering how all operations which proceed from nature and passion, are perform'd among living creatures: and therefore, I conceive, I have thereby sufficiently compli'd with the obligation of my intention; which is but to express and shew in common, how all the actions of sensible bodies may be reduced to local motion and material application of one body to another, in a like manner (though in a different degree) as those motions which we see in lifeless bodies: Yet because, among such animals as pass for irrational, there happen some operations of so admirable a strain, as resemble very much the highest effects which proceed from a man: I think it not a miss, to give some further light, by extending my discourse to some more particulars, than hitherto I have done; whereby the course and way, how they are performed, may be more clearly and easily look'd into. And the rather, because I have met with some men; who (either wanting patience to bestow, on thoughts of this kind, so much time as is necessary for the due scanning of them, or else, through a promptitude of nature, passing swiftly, from the effect they look upon in gross, to the most obvious seeming cause) suddenly and strongly resolve, that beasts use discourse upon occasions, and are endued with reason.

Yet I intend not here to run through all the several *species* of their operations, for that were to write the history of every particular animal; but will content my self with touching the causes in common: yet in such sort, that the indifferent Reader may be satisfied of a possibility, that these effects may proceed from material causes; and that I have pointed out the way to those who are more curious, and have the patience and leisure to observe diligently what passes among beasts, how they may trace these effects from step to step, till at length they discover their true causes.

To

<sup>I.</sup>  
The order and  
connexion of  
the subsequent  
Chapters.



To begin then. I conceive we may reduce all those actions of Beasts, which seem admirable and above the reach of an irrational animal, to three or four several heads. The first may be of such, as seem to be the very practice of reason; as doubting, resolving, inventing, and the like. The next shall be of such, as, by docility or practice, beasts oftentimes arrive to. In the third place, we will consider certain continue actions of a long tract of time; so orderly perform'd by them, as that discourse and rational knowledge seem clearly to shine through them. And lastly, we will cast our eye upon some others, which seem to be even above the reason that is in man himself; as, the knowing of things which the sense never had impression of before, a prescience of future events, providences, and the like.

2.  
From whence  
proceeds the  
doubting of  
beasts.

As for the first, the doubting of Beasts, and their long wavering sometimes between objects that draw them several ways, and at last their resolving upon some one of them, and their steady pursuance of that afterwards, these will not be matter of hard digestion to him, that shall have well relished & meditated on the contents of the last Chapter. For, 'tis evident, that, if several objects of different natures at the same time present themselves to a living creature, they must of necessity make divers impressions in the heart of it, proportionable to the causes from whence they proceed: so that, if one of them be a motion of hope, and the other of fear, it cannot choose but follow thence, that what one of them begins, the other will presently break off. By which means it will come to pass, that, in the Beasts heart, there must needs be such waverings as we may observe in the Sea, when, at the beginning of a tide of flood, it meets with a bank that checks the coming in of the waves, and, for a while beats them back as fast as they press upon it: they offer at getting over it, and by and by retire back again from the steepness of it, as though they were apprehensive of some danger on the other side; and then again attempt it afresh, and thus continue labouring, one while one way, another while another; till, at length the flood increasing, the water seems to grow bolder, and breaks again over the banks, and then flows on till it meets with another that resists it, as the first did. And thus you see, how the Sea can doubt



doubt and resolve, without any discourfing. In like manner it fares with the heart of a Beast ( whose motions fteer the reft of the body ), when it beats between hope and fear, or between any other two contrary paffions; without requiring any other principles from whence to deduce it, than thofe we have already explicated.

But now to fpeak of their invention: I muft confefs that, among feveral of them, there appears fo much cunning in laying of their plots ( which when they have compaffed, they feem to grow carelefs and unbend their intention, as having obtain'd what with earneftnefs they defired ), that one might think they wrought by design, and had a diftinct view of an end; for the effecting of which, they ufed difcourfe to choofe the likelielt means.

To this purpofe the fubtilties of the Fox are of moft note. They fay, he ufes to lie as if he were dead; therby to make Hens and Ducks come boldly to him. That, in the night when his body is unfeen, he will fix his eyes upon poultry; and fo make them come down to him from their roof. That, to rid himfelf of the fleas that afflēt him in the Summer, he will fink his body by little and little into the water, while the fleas creep up to his head ( to fave themfelves from drowning ) and from thence to a bough he holds in his mouth; and will then swim away, leaving them there. That, to coufen the Badger of his earth, he will pifs in it; as knowing that the rank fmell of his Urine will drive the other cleanlier beaft to quit it. That, when Dogs are clofe upon him and catching at him, he will pifs upon his Tail, and, by firking that up and down, will endeavour ( you may believe ) to make their eyes smart; and fo retard their purfuit, that he may efcape from them.

And there are particular ftories, that exprefs yet more cunning than all thefe. As, of a Fox, that, being fore-hunted, hang'd himfelf by the teeth among dead vermin in a Warren; till the Doggs were paff'd by him, and had loft him. Of another, that, in like diftrefs, would take into his mouth a broom bufh growing upon a fteep cliff on the fide hand neer his Den ( which had another way to it, eafie enough of accefs ) and, by help of that, would feecurely caft himfelf into his

3.  
Concerning  
the invention  
of Foxes and  
other beaft.



his hole, while the Dogs, that follow'd him hastily and were ignorant of the danger, would break their necks down the rocks.

'Tis said, that, in *Thracia*, the Countrey people know whether the rivers, that are frozen in the winter, will bear them or no, by marking whether the Foxes venture boldly over them, or retire, after they have lai'd their ears to the Ice, to listen whether they can hear the noise of the water running under it: from whence (you may imagine) they collect, that, if they hear the current of the stream, the Ice must needs be thin; and consequently dangerous to trust their weight to it.

And, to busie my self no longer with their subtilties, I will conclude with a famous tale of one of these crafty animals, that, having kill'd a Goose on the other side of the river, and being desirous to swim over with it, to carry it to his den; before he would attempt it (lest his prey might prove too heavy for him to swim withal, and so he might lose it) he first weigh'd the Goose with a piece of wood, and then tri'd to carry that over the river, whiles he left his Goose behind in a safe place: which when he perciev'd he was able to do with ease, he then came back again, and ventured over with his heavy bird.

They say it is the nature of the *Iacatray* to hide it self, and imitate the voice of such beasts, as it uses to prey upon: which makes them come to him, as to one of their own fellows; and then he seises on and devours them.

The *Iaccal*, that has a subtile sent, hunts after beasts, and, in the chase, by his barking, guides the Lion, (whose nose is not so good) till they overtake what they hunt; which peradventure would be too strong for the *Iaccal*: but the Lion kills the quarry, and, having first fed himself, leaves the *Iaccal* his share; and so between them both, by the ones dexterity and the others strength, they get meat for nourishment of them both.

Like stories are recorded of some Fishes. And every day we see the invention of Beasts to save themselves from catching: as Hares, when they are hunted, seeks always to confound the sent; sometimes by taking hedges, otherwhiles waters; sometimes running among sheep and other beasts of stronger sent; some



sometimes making doubles, and treading the same path over and over; and sometimes leaping with great jumps hither and thither, before they betake themselves to their rest, that so the continuateness of the sent may not lead doggs to their form.

Now, to penetrate into the causes of these and of such like actions; we may remember, how we shew'd in the last Chapter, that the beating of the heart works two things: one is, that it turns about the *specieses*, or little corporeities (streaming from outward objects) which remain in the memory; the other is, that it is always pressing on to some motion or other. Out of which it happens, that, when the ordinary ways of getting victuals or escaping from enemies, fail a creature whose constitution is active; it lights sometimes (though peradventure very seldom) upon doing something, out of which the desired effect follows (as it cannot choose but fall out now and then, though chance only govern their actions): and, when their action proves succesful, it leaves such an impression in the memory, that, whenever the like occasion occurs, that animal will follow the same method; for the same *specieses* do come together from the memory into the fantasie. But, the many attempts that miscarry, and the ineffectual motions which straights do cast beasts upon, are never observ'd; nor are there any stories recorded of them: no more than, in the Temple of *Neptune*, were kept upon the registers the relations of those unfortunate wretches, who, making vows to that God in their distress, were nevertheless drowned.

Thus peradventure, when the Fox sees his labour, in chasing the hens, to be to no purpose, and that, by his pursute of them, he drives them further out of his reach; he laies himself down to rest, with a watchful eye; and perceiving those silly animals to grow bolder and bolder, by their not seeing him stir, he continues his lying still, till some one of them comes within his reach; and then, on a sudden, he springs up and catches her. Or peradventure, some poultry might have strai'd within his reach whiles he was asleep; and have then wakened him with some noise they made; and so he happned to seise upon one of them, without either design or pains taking beforehand;

4.  
Of Foxes that catch hens by lying under their roost and by gazing upon them.



hand. By such degrees he might chance to catch one the first time : and they, being settled in his memory, together with the effect, it hap'ned that, another time when hunger pressed him and sent up to his brain like spirits to those which ascended thither, whiles he lay watching the hens ; these spirits brought the other from his memory into the fantasie (in such sort as we have shew'd in the last Chapter), and so drove him to the same course, till by frequent repetition, it became ordinary and familiar with him. And then, they, that look only upon the performance of the artifice, are apt to infer discourse and a design of reason, out of the orderly conduct of it.

But how can we concieve the Fox hath judgment, to know when the hen is come within his leap, and accordingly offers not at her, till then ; unless we resort to some other principles, than what is yet declared ? The answer to this objection I think will not be hard to find : for if the motion, which the presence of the object makes in the heart, be proportion'd out by nature (as there is no doubt but it is), it will not be so great and powerful, as to make the Fox leap at it, till it be arrived so near him, that he, by his nimbleness, can reach it ; and so without any aim, further than by the meer flux of his passion conveniently rais'd, he doth the feat. But, if his passion be too violent, it makes him miss his aim : as we may frequently observe both in men and beasts ; and particularly, when fear presses either of them to leap over a ditch, which being too broad, he lights in the midst of it.

The same watchfulness and desire to have the poulten, which then sit upon a tree out of his reach, makes him fix his eyes on them, when they are at roost ; and at length, either the brightness and sparkilng of them dazles the birds, and makes them come down to him, (as flies do in the night about the flame of a candle, or as fishes do to a light in a boats head) ; or else they are afraid ; and their fear increasing, their spirits return to the heart, which therby is oppressed, and their outward parts are bereav'd of strength and motion : from whence it follows necessarily, that their footing looses their hold fast, and they tumble down half dead with fear ; which happens also frequently to cats, when they look wishly upon little birds that sit quietly. Or peradventure, their fear makes them giddy :

as



as when some man, looking down a precipice from a dangerous standing, falls, by the turning of his brain, though nothing be behind him to thrust him forwards. Or it may be, some steam comes from the Fox, which draws such creatures to him: as 'tis reported that a great and very poisonous Toad will do a Weasel, who will run about the Toad a great while, and still make his circle lesser and lesser, till at length he perishes in the center, were his foe sits still, and draws him to him. Which he doth in such sort, as animated *Mercury* will draw leaf-gold duly prepared, or as the Load-stone attracts Iron: and yet 'tis apparent, the Weasel comes not with his good will, but that there are some powerful chains, steaming from the body of the Toad, which pluck him thither against his liking; for, by his motions and running, he will express the greatest fear that can be.

The method which Foxes practise to rid themselves of their fleas (if it be true) is obvious enough for them to fall upon: for in Summer, their fleas, together with their thick fur'd coat, cannot choose but cause an exceeding great itching and heat in their bodies; which will readily invite them to go into the water to cool themselves. As the Merchants, at the Isles of *Zante* and of *Cephalonia*, told me (when I was there), it was the custom of our English Dogs (who were habituated to a colder clime) to run into the Sea in the heat of Summer, and lie there most part of the day, with only their noses out of the water, that they might draw breath; and would sleep there with their heads laid upon some stone; which raised them up, whiles their bodies were cover'd with the Sea: and those Dogs which did not thus, would, in one Summer usually, be kill'd with heat and Fleas.

Now, when the Fox feels the ease that the coolness of the water affords that part of him which sits in it, he goes further and further; yet would not put himself to swim (which is a labour, and would heat him, and therefore he avoids it): so that whiles he thus cools himself in some shady place (for, 'tis natural to him, in such an occasion, to resort to the cool shade, rather than to lie in the Sun) and in such there being for the most part some boughs hanging over the water; it happens naturally enough, that he takes

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some

s.  
From whence  
proceeds the  
Foxes inven-  
tion to rid  
himself of  
Fleas.



some of the lowest in his mouth, to support him and save him the labour of swimming, whiles he lies at his ease, soaking and cooling himself in the River. By which means it comes to pass, that the Fleas, finding no part of him free from water, creep up the bough to rescue themselves from drowning: and so, when he is cool'd enough, he goes away and leaves them there. In all which finding a benefit and satisfaction, whenever the like occasion brings those *species* from his memory into his fantasy, he betakes himself to the same course; and therein finding his remedy, at length it grows familiar to him.

In like manner, *Thales* his Mule, that was heavily loaden with Salt, hap'ning to stumble and fall in a River, she was going over; the Salt melted by the water soaking into the sacks, and so she was eased of her burthen: which success made her, that whenever she came to a River, and was troubled with her loading, she would lie down in the water; and could not be reclaim'd from it, till they charged sacks of wooll upon her back, which, growing heavier by their imbibing of water, wean'd her from her former crafty habit. By which 'tis apparent, that it was memory, and not judgment, which made her for a while behave her self so subtilly.

6.  
An explication  
of two o-  
ther inventi-  
ons of Foxes.

For the Foxes driving the Badger from his earth, you will not think it needful to allow him a forecast or design in pissing in it: but, as it natural for him, to rest in a place that he meets with, fit for that purpose, so it is for him to piss in it, if the list take him while he is there; which in all likelihood it will, if he stay any time there, and give a relaxation to all his parts by sleep.

And, when he pisses in his tail and shakes it in the Dogs eyes, 'tis evident that fear, not craft, causes this effect; for it avails him little, and therefore is not likely to proceed from judgment: and of the other, when 'tis violent, 'tis a natural effect in all beasts, to contract their tails between their legs, and to make their urine come from them, (by compressing the spirits in their heart, which should support their outward parts, and strengthen their splinctor muscle); which then being snap'd at and seis'd on by the Dogs shakes from their bushy tails (fit to retain it); and then, lighting in the Dogs eyes.

the



the acrimony of it hurts them, and makes them shut their lids.

The story (if it be true) of the Fox, that, to save himself from the Dogs he heard following him in full cry, hung by his teeth among dead vermine in a warren, is a very strange one, I confess. But 'tis conceivable, how fear and weariness might cause him to seek a shelter to hide himself; and, in so plain a tract of ground, as warrens use to be, without any bush or hill to have recourse to for relief, there appearing nothing but a gallows hanging full of vermine, his fantasy might be moved (he being able to run no further) to thrust himself among those dead bodies, that he saw rest quietly: and, having no way to mingle himself with them but hanging by his teeth, he might continue in that posture, till the Dogs, not suspecting him in the air, might run under him and overshoot the sent; which whiles they cast about to recover, by runing to beat the next wood or shelter in view (as is their custom in losses of their chace, to which they are brought by their masters hunting them in that method at the first) the wily animal steals another way, and recovers himself.

This over-runing of the sent by Dogs, in the earnestness of their chace puts me in mind of *Montagues* Argument, out which he will infer, that Dogs use discourse and make syllogisms in their hunting: for (saies he) when they have follow'd their chace down a Lane, that, at length, divides it self into three others, they will carefully smell at the first and second, and, not finding that it has gone in either of those, they boldly run upon the third, without ever laying their Noses to the ground; as being assured by their discourse and reason, that, since it went not in the two first, and there being but one remaining, it must of necessity have gone there.

7.  
Concerning  
*Montagues*  
argument, to  
prove that  
Dogs make  
syllogisms.

But this needs no other cause, than that their eagerness of hunting having made them overshoot the sent, (which for a while remains in their noses, after they are parted from the object that caus'd it), they cast back again (as they are accusom'd to be made to do, in like occasions, by the hunters that train them up), and with their noses try the ground all the way they go; till, coming near where the chace went indeed, the



sent strikes their Noses (that by this time are grown empty of it) before they come at the place : and then they run amain in pursuit of it, with their heads held up, (which is their convenientest posture for runing), and all the way the sent fills them at that distance, without their needing to smell upon the Earth, to fetch it from thence.

8.  
A declaration  
how some  
tricks are per-  
form'd by  
Foxes, which  
seem to argue  
discourse.

That Fox, which used to cast himself by the advantage of a bough into his Den, was so closely pursued by the Dogs, the first time he ventured upon this feat, that he had not time to go into his Earth (his ordinary retreat, when he is near it) by the easy and accessible way : but, on one side, to get thither being strong in his fantasy, and on the other side, the precipice, which he had often seen, coming likewise thither from his memory ; these two concurring could not choose, but make him go warily thither. And in so dangerous a leap, 'tis natural for him to help himself by any thing in the way that can advantage him ; which hapning to be by catching in his mouth a bough that hung over his Den, (the only suddain means he had to take hold of any thing), and from thence taking, as it were, a new rise for a second leap, he finds himself in security : whiles the Dogs, unacquainted with the place, run violently on, as in the rest of their chase, and so are upon the brim of the precipice, before they perceive it ; and then it is too late for them to stop their course, and consequently they break their necks. Which mischief to them the Fox needs not have in his design, and accordingly tolle them that way ; but, chance begetting this deliverance of him at the first when he was so hard pressed, his memory teaches him to follow the same course, whenever the lik occasion occurs.

But, how many Foxes perish in attempts, which, if they succeeded, would have been accounted by slight iudgers to be notable subtilties ; but miscarrying, are esteem'd tumultuary motions without design, caus'd by that animals fantasy and spirits, when he is in extremity ? I remember how, upon a time when I was hunting one, he, being hard set, and but a little before the Dogs and Hunters, caught in his mouth the bough of a 'crooked Ash-tree, and run up a pretty way : which being in a hedge, he therby hung down along the side of  
the



the hedge, and when we struck him over the ribs with our poles, he would not quit his hold, (so strongly the fear of the dogs wrought in his fantasy), till greater blows knock'd him on the head. Which shews evidently, that this action was the effect of chance pressing his fantasy to do something; and not any reason or discourse providing for his safety: as we have already said, upon occasion of the other hanging among the dead vermin in the Warren.

Those in *Thracia* that will not go over a frozen River, when the yce is too thin to bear them, are by their memory, not by their judgment taught to retire; for at other times they have been wetted, when they have heard the noise of the stream running under the yce: or, the very running of the water calls the *specieses* of swimming out from their memory along with it into their fantasy (neither of which is pleasant to them in the winter); and so disliking the noise, for the other effects sake that used to accompany it, they avoid that which begets it, and so retire from the river. And the reason of their listening to the noise proceeds from the spirits, that their passion, upon apprehension of a danger, presses into the nervs of their senses, as well as into the other nervs of their brains: which accordingly makes them so vigilant, and attentive then to outward objects and motions.

That the *Jaccatray* or *Hyena*, when he is hungry, should have his fantasy call out from his memory the Images of those Beasts which use to serve him in that occasion, is the ordinary course of nature; and that, together with those Images, there should likewise come along the actions and sounds which used to accompany them, and are lodged together with them in the memory, is also natural: then, as little strange it is, that by his own voice he should imitate those sounds which at that time so powerfully possess his imagination. And, having a great docility in those Organs which form the voice, like a *Parrat*, he represents them so lively, that the deceived beasts flock to him, and so are caught by him: which at first happens by chance; but afterwards by memory, and grows familiar to him.

Nor can we imagine, that the *Jaccal* hath a design of serving the *Lion*; but his nature being (like a Dog) to bark when

9.  
Of the *Jaccatray's* invention in calling beasts to himself.

10.  
Of the *Jaccals* designe in serving the *Lion*.



he feels the sent hot ( which he pursues for his own sake ), the Lion, that dwells in the same woods with him, meets with the noise and follows it; and peradventure would kill the *Jaccal* himself, as well as what he hunts, if he could overtake him: but he, being too nimble for the Lion, keeps out of his reach; till, having wearied the beast he chases, the Lion, that follows by the cry, comes in when he is at a bay, and soon tears in pieces what the other had not strength enough so suddenly to master, and feeds himself upon the Quarry, till he be full. All this while the *Jaccal* dares not come near the Lion, but stands at a distance with fear, waiting till he have done, and then, after he is gone away, he takes his turn to feed upon what his surly Master hath left.

II.  
Of several  
intentions of  
Fishes.

The like reason, 'tis probable, we might find out, among those Fishes that serve one another; if we had the conveniency of observing particularly how they behave themselves: as when the *Whale* hath service from his little guide ( if the report be true; which is a necessary circumstance to be inserted in every such tale ), and others of the like strain.

The subtilty of the *Torpedo* ( who hides himself in the mud to benum Fishes, that may afterwards serve him to feed upon ) will not require to have its origin from reason, and be done by design: when you shall consider it is natural for such cold Creatures to immud themselves, and then the Fishes that swim within the reach of his benumbing faculty will be stai'd and frozen there ( which, because they see him not, they apprehend not, till it be too late for them to avoid it ); and then, when the *Torpedo* comes out, he feeds upon what he finds lying ready in his way.

And in like manner, the *Scuttle-fish*, when he is in straits of being taken by the Fishermen, casts out a blackness that is within him; and so, making the water become like Ink, he oftentimes escapes their hands in the darkned Element: which

I:  
A discovery of  
divers things  
done by Hares  
which seem to  
argue dis-  
course,

arises from no discourse of his; but fear makes him void this liquor that is in him ( as it made the Fox void his Urine ), and in consequence ther' to the effect follows.

Lastly, when *Hares* use those means we have mention'd, to confound the sent and save themselves from the Dogs that



that hunt them ; we may observe, that they take therein the readiest ways, and the most obvious to sense, to avoid the evil they flie from. For, what can be more direct to that effect, than to hide themselvs in Hedg-bottoms, or in Woods? Or to swim over a River, when that is the most immediate way to run from the Dogs? And when they are in a plain, where there is no other shelter but flocks of Sheep or herds of Deer, what can be more natural, than for them to hide themselvs among them, and run along with them; till the cry of the approaching Hounds fright them away, while those tamer beasts abide it neerer?

Their doublings backward and forward may proceed from their fear, that diverts them still from the way they are in at present; till the Dogs coming near put them out of those wavering, and makes them run straight away: for they never double, but when they are a great way before the dogs, and do not hear them. Or else it may be, that, not hearing or seeing the dogs, their fear may be almost passed; and then the agitation which their spirits are in, governs the motions of their body, and will not let them rest, till they be more appeased, (as you may see weary people, that at their first ceasing from running, cannot sit still: the like of which happens also frequently in the motions of joy or of anger), and so it makes them walk backwards and forwards, in a pace proportionate to the agitation of the spirits within: and sometimes those moved spirits make them bound and leap to and fro (like the Loaf with Quicksilver, we have heretofore spoken of) as they issue from the heart by pulses and strokes; which happens when they begin to settle towards rest. Or else peradventure their form is so framed, that, if they should get into it otherwise, than by a jump, they would disorder some part of it; and so be unfenced and a cold, or otherwise at uneasie, during their repose: and therefore their jumping to and fro, before they leap plumb in, is to take their aim (not much unlike to Dogs, turning about several times before they lie down); for Hare-finders (who use to watch them, say they will do thus, though they be not pursued. And thus these actions which are imputed to craft, therby to confound the Dogs, or to wisdom, to walk themselvs till they be grown into a



fitting temper to sit still; may all of them be reduced to those material and corporeal causes, which make them to do their other ordinary motions, wherein we find no difficulty.

13.  
Of a Fox reported to have weigh'd a Goose, before he would venture with it over a River; and of fabulous stories in common.

If that of the Foxes weighing his Goose, before he would venture to carry it over the River, were plainly true, as it is set down; I avow, I should be hard set, to find the principles from whence that discretion in him proceeded: but I conceive this tale may be paired with that, which tells us of another Fox, who, having his prey taken from him by an Eagle, brought the next day a new prize into the same place, having first rolled it in the fire, so that some burning coals stuck upon it; which the Eagle coming again and snatching from him, carried to her Nest, which was thereby set on fire, and the young ones, falling down, became the Foxes share, instead of what their Dam had rob'd him of. Such stories, so quaintly contrived, are fitter for a moral, than for a natural Philosopher. *Æsop* may entertain himself and his Disciples with them; whiles all the reflection I shall make upon them, is, that when I hear any such finely order'd Tales, I cannot doubt but they are well amended in the relation, by those that tell them: it being the inclination and custom of most men, (partly through a desire of having strange things come from them, and partly out of a care that what they say may appear like truth, and so be the easier believ'd) to add circumstances beyond the truth of the matter; which increasing at every new mans relation of the same accident (for this humour reigns very generally), at length, so handsom and yet so strange a Tale is composed, that the first Author or Teller of it, wonders at it as well as others, and cannot discern that his story begot this latter.

Therefore, when one of these fine tales is proposed to speculate on, and that I have no light to guide me in determining what part of them to allow, and what to reject; I think it better to expect an authentick record of it, than to be too hasty at guesses: leaving such as pretend ability in reading of Riddles, to descant of the ways how such actions may be effected. But for others, that have a semblance of truth or happen ordinarily, be they at the first sight never so like the operations of reason, I doubt not, but the causes of them may be reduced to the



the principles we have already established; and the waies of performing them may be pitched upon by such discourses about them, as we have made about those examples we have above produced. Especially, if the actions themselves were observ'd by one that could judg of them, and were reported with a desire of expressing the truth nakedly as in it self it lieth: for, divers times it happens that men, saying nothing but truth, express it in such a manner and with such terms, that the ignorant hearer conceives the thing quite another way, than indeed it is, meerly for the too emphatical expressions; especially, if the relator himself misses in conceiving the true causes of what he reports, and so expresses it proportionably to those which he apprehends.

To conclude then this first branch; we see how the Doubting, the Resolving, the Aiming, the Inventing, and the like, which we experience in Beasts, may, by the *vestigia's* we have traced out, be follow'd to their root, as far as the division of Rarity and Density: without needing repair to any higher principle, but the wisdom of the Orderer and Architect of Nature, in so admirably disposing and mingling these material, gross, and liveless bodies, that strange effects, and incomprehensible to them who will not look into their several joints, may follow out of them, for the good of the creature in whose behalf they are so order'd.

But, before we go to the next point, we cannot forbear mentioning their vanity, as well as ignorance, who to purchase the estimation of deeper knowers of Nature, would have it believ'd, that Beasts have compleat Languages, as Men have, to discourse with one another in; which they wanted they had the intelligence of. 'Tis true, that, in us, speaking or talking is an operation of reason; not because it flows immediately from reason, but because by the command and direction of reason 'tis form'd, and is no where to be found without reason: which those irrational Philosophers which pretended to understand the Language of Beasts, allow'd them, as well as the ability of talking to one another; but it was because they had more pride than knowledg. Of which rank one of the chief was *Apollonius*, surnamed from *Thyana*: for, if he had known how to look into the nature of beasts, he would have perceiv'd the reason of the divers voices, which the same beast in divers occasions forms.

14.  
Of the several  
Cryings and  
Tones of  
Beasts: with a  
refutation of  
those Authors  
who maintain  
them to have  
compleat Lan-  
guages.

This



This is evident, that an Animals lungs and chest, lying so neer as they do, to his heart; and all voice being made by the breath's coming out of his mouth and through his windpipe: it must necessarily follow, that, by the divers ordering of these instruments, his voice will become divers; and these instruments will be diversly order'd in him, according to the divers motions of his heart, that is, by divers passions in him, (for so we may observe in our selves, that our breath is much changed by our being in passion). And consequently, as a beast is agitated by various passions, he must needs utter variety of voices; which cannot choose but make divers impressions in other beasts, that have commerce with him, whether they be of the same kind as he is, or of a different. And so we see, that, if a Dogg, setts upon a Hog, and the bitten hogs cry makes an impression in the other Hogs, to come to their fellows rescue; and in other Dogs to run after the crying Hog: in like manner, anger in a Dog makes snarling or barking, pain, whining, desire, another kind of barking; and his joy of seeing a person that he uses to receive good by, will break out in another kind of whining. So in a Hen, her divers passions work divers kinds of clocking; as, when she sees a Kite, she hath one voice, when she meets with meat another, when she desires to gather her Chickens under her wings, a third: and so, upon divers occasions, a divers sound; according to the divers ordering of her vocal instruments, by the passion which presses her heart: So that, who would look curiously into the motions of the variously disposed vocal instruments of Beasts, and into those of the spirits about a Beasts heart (which motion, we have shew'd, is passion) would be able to give account, why every voice of that beast was such a one, and what motion about the heart it were that caus'd it.

And as much may be observ'd in Men, who, in pains, and griefs, and other passions, use to break out into those voices, which we call Interjections; and which signifie nothing in the Understanding of them that form them, but to the Hearer are signs of the passion from whence they proceed: which if a man heedfully mark in himself, he will perceive, that they are nothing else, but the sudden eruptions of a great deal of breath together; caus'd by some compression made within him, by the  
 pain



pain he is in. Which is the reason, that the striving against groaning, in certain occasions, doth sick persons much harm: for, it disorders the natural motions of some principal parts within them, that are already too much agitated; and the counter motion, by which they are check'd, puts them further into a more violent agitation. In the observation of these natural eruptions of mens breath, caus'd by passion, our Forefathers of old were so industrious; as to transfer the imitation of nature in this particular into Musick: so that their kinds of Musick were distinguish'd, according to the division of mens passions; and, by similitude, would raise them in the hearers.

Out of this discourse also a reason may be given, why Birds are more musical, than other creatures; to wit, because they are of a hotter complexion, and therefore, to their bigness require more breath and air to cool them; and consequently make more noise, and more variety of it. Likewise, among Beasts, Doggs are the most vocal of any that converse with us; who, by their ready anger, appear to be the hottest. Among Men, those that are merry, or soon become heated with a little wine, are given to talking or singing: and so are children, and women likewise; not so much through abundance of heat, as because their heat doth easily vent.

And thus 'tis evident, that there is no true Language among Beasts: their voices not being tokens of divers things or conceptions, but meerly the effects of divers breathings, caus'd by divers passions. Wherefore, since both breathing and passion are easily reduced to the common principles of Rarity and Density; we need not trouble our selves any further, to seek into the origine of this vocal faculty of Beast.



## CHAP. XXXVII.

*Of the Docility of some irrational animals : and of certain continue actions of a long tract of time, so orderly perform'd by them, that they seem to argue knowlegde in them.*

I.  
How Hawks  
and other  
creatures are  
taught to do  
what they are  
brought up to.

**A**S for Docility, (which is our second head), Apes and Elephants are most famed. Though peradventure, the cunning and obedience of our Hawks and Dogs is no whit inferiour to what is reported of them; and would be as much admired, were it not so common. I have, by sundry persons who have seen him, been told of a Baboon, that would play certain Lessons upon a Gittar. The *Indian Histories* make mention of Apes, that will go to the Tavern and fetch Wine for their Masters; as *Lipsius's* Dog would bring his Master, as much meat from the Market, as he carried money to his Butcher to pay for. Of Elephants likewise strange things are told. But, because we cannot easily judg how to understand reports, wherof we have not seen the experience, nor how far to believe them; I intend not to insist upon the examining of them; for, by looking into the nature and art of our Hounds that follow a sent of bloud, or that draw dry foot; and of our Hawks, especially of the decoy-Ducks and Cormorants; a guess may be given at all the rest. And although these things, told at random, may justly seem very admirable to any man, the first time he hears of them; yet, to him that understands how they are taught, there is no one passage but will appear plain enough.

The first degree is, to tame the Hawk, by watching her from sleep; and to acquaint her with the man, by continually carrying her upon his fist, and using her to take her meat quietly, as she sits upon his hand. Then he makes her hop a little way to it in a pair of cranes, and after a while, kill a feeled pigeon; from which he takes her, when she is grown steady in her lesson so far, and feeds her up with other meat: and thus, in time, he brings her to his flie at what he will have her, and to be content with



with a small reward ; leaving her quarry to her Master. So that a spectator , who understands not the Myſtery nor ever ſaw Hawking before, may well admire to ſee a Bird ſo dutifully and exactly obey a mans command; and may conceive ſhe has a reaſonable ſoul, wherby to underſtand him and diſcourſe of the means to bring his purpoſe to effect : wheras indeed, all this is no more , than to make her do, for you, and when you pleaſe, the ſame which ſhe doth by nature to feed herſelf.

The cunning of Dogs is begotten the ſame way. Coy-ducks are beaten and whip'd to what they are taught; like ſetting-dogs. Cormorants have their throats tied, that they may not ſwallow the fiſh, they catch; but be conſtrain'd to bring it to the man that imployſ them. So that, looking along ſtep by ſtep, you ſhall meet with nothing but what is plain and eaſie to be taught, and performed by ſenſe and memory; without needing to attribute any diſcourſe or reaſoning to beaſts.

Apes are likewise taught, as dogs may be, to carry things to a certain houſe; where, receiving what is given them, they return home with it: and you may be confident, this ſerviceableneſs of the Ape grew out of his being carried firſt to the Tavern by the maid or boy, who there gave him ſomewhat that pleaſ'd him; and then being made to carry the pot along by the boy; and afterwards money in one hand, and the pot in the other, wherof ſome drawer diſcharg'd him, taking the one, and filling the other, and withall giving him a reward, which alſo was repeated to him, at his return home with his full pot: till at laſt, when he was ſufficiently uſed to this exerciſe, he would of himſelf, go ſtraight thither, as ſoon as he was harneſſed ſo, as he uſed to be for this ſervice. Which appears to be aſſuefaction and cuſtome, not judgment; by his receiving indifferently whatever is put into his pot.

And, by the Tale of *Lipſius's* dog; from whom other leſs dogs ſnatching, as he troted along, part of what hung out of his Basket (which he carried in his mouth), he ſet it down to worry one of them: whiles, in the mean time, the others fed at liberty on the meat that lay there unguarded; till he, coming back to it, drove them away, and himſelf made an end  
of



of eating it up. Wherby we may concieve, that the *species* of carrying his basket to his Master (which custome had settled in his memory) was disorder'd and thrust out of his fantasie, by a stronger, of fighting, for his meat with the other currs: after which it follow'd naturally in his fantasie, to eat what he had fought for. And that sending then spirits into his nervs, agreeable to the nature of it, and governing the parts depending of the brain; a motion and action ensued, which was suitable to the object in the fantasie; and this could be none other, but of eating what the fantasie found conformable to its nature.

2.  
Of the Baboon  
that plaid on  
a Guittar.

The Baboon, we have mention'd, might be taught some lessons made on purpose with very few stops, and upon an instrument wheron all the strings may be stricken with one blow, and but one fret to be used at a time, and that fret to be stopp'd with one finger: of which much labour and time might beget a habit in him; and then, imitation of the sound might make him play in due measure. And, if we will mark it in our selves, we shall see that, although, in the first learning of a lesson on the Lute, we imploy our reason and discourse about it; yet, when we have it very perfect, our fingers (guided by a slight fantasie) fall by custome, without any reflection at all, to play it as well, as if we thought never so carefully upon it. And there is no comparison, between the difficulty of a Guittar and of a Lute.

3.  
Of the teach-  
ing of Ele-  
phants and o-  
ther beasts to  
do divers  
tricks.

I have been told, that at the Duke of Florence's marriage, there was a dance of Horses, in which they kept exact time of Musick. The means used for bringing them to it, is said to have been, by tying and hampering their legs in such a sort, that they could lift them up, but in a determinate way: and then setting them upon a pavement, that was heated underneath so hot that they could not endure to stand still; while such Musical Aires were plaid to them, as fitted their motions. All which being often repeated, the Horses took a habit, that, in hearing those Aires, they would lift up their legs in that fashion; and so danced to the tune they had been taught.

Of the Elephants, 'tis said that they may be taught to write; and that, purely upon words and commanding them, they'll do what they are bidden; and that they are able to keep ac-  
count;



count; and will leave working at a precise number of revolutions of the same action, which measures out their task to them. All which (as I said before), if it were plainly and literally true, would require a very great consideration: but because the teachers of Beasts have certain secrets in their art, which standers by, do not reach to, we are not able (upon such scanty relations, as we have of them) to make sufficient judgment how such things are done; unless we had the managing of those creatures, wherby to try them in several occasions, and observe what cause produces every operation they do, and by what steps they attain to their instructions and serviceableness.

'Tis true, the uncontrolled reports of them oblige us to believe some extraordinary matter of their docility, and of strange things done by them: but with all, the example of other taught-beasts among us, and of the strange judgments that are made of them, by persons who do not penetrate into their causes, may instruct us how easily it is to mistake the matter; and assure us, that the relations made us do not always punctually agree with the truth of what passed. He that should tell an *Indian* what feats *Banks's Horse* would do; how he would restore a glove to the due owner, after his Master had whisper'd that mans name in his ear; how he would tell the just number of pence in any piece of silver coyn, barely shew'd him by his Master; and even obey presently his command, in discharging himself of his excrements, when ever he bad him (so great a power art may have over nature:) would make him, I believe, admire more at this learned beast, than we do at their docile Elephants, upon the relations we have of them. Whereas, every one of us knows, by what means his painful Tutor brought him to do all his tricks; and they are no whit more extraordinary, than a Fawkners manning of a Hawk, and training her to kill Partridges, and to flie at the retrieve: but do all of them (both these, and all other juggling artifices of beasts) depend upon the same or like principles; and are known to be but directions of nature, order'd by one that composes and levels her operations to another end further of off (in those actions) than she of her self would aim at. The particulars of which, we need not trouble our selves to meddle with.

But



4.  
Of the order-  
ly train of  
actions per-  
form'd by  
beasts, in  
breeding their  
young ones.

But, 'tis time we come to the third sort of actions perform'd by beasts, which we promised to discourse of. These seem to be more admirable, than any we have yet touch'd; and are chiefly concerning the breeding of their young ones. Above all others, the orderly course of Birds, in this affair, is most remarkable. After they have coupl'd, they make their nest, they line it with moss, straw and feathers; they lay their eggs, they sit upon them, they hatch them, they feed their young ones, and they teach them to fly: all which they do with so continue and regular a method, as no man can direct or imagine a better.

But, as for the regularity, orderliness, and continuance of these actions, the matter is easie enough to be conceiv'd. For, seeing the operation of the male makes a change in the female; and this change beginning from the very first, grows by time into divers proportions: 'tis no wonder that it breeds divers dispositions in the female; which cause her to do different actions, correspondent to those divers dispositions. Now, those actions must of necessity be constant and orderly, because the causes, whence they proceed, are such.

But, to determine in particular, how it comes to pass, that every change in the female disposes her to such and such actions, there is the difficulty; and it is no small one: as well for that there are no careful and due observations made, of the effects and circumstances which should guide us to judg of their causes; as because these actions are the most refined ones of Sensitive creatures, and flow from the top and perfection of their nature, and are the last strain of their utmost vigour, to which all others are subordinate. As, in our enquiry into the motions and operations of the bodies of a lower Orb, than these, we meet with some (namely, the Loadstone, and such like) of which it is very hard to give exact and plain account; the Author of them reserving something from our clear and distinct knowledge, and suffering us to look upon them but through a mist: in like manner we cannot but expect, that, in the depth of this other perfecter nature, there must be somewhat wherof we can have but a glimering and imperfect notion. But as in the other, it serv'd our turn, to trace out a way how those operations might be effected by bodies, and by local motion



motion (though peradventure, we did not in every circumstance hit exactly upon the right); therby to defend our selves from admitting those chymical Qualities, which we had already condemned upon all other occasions: so, I conceive, it will be sufficient for us in this, to shew how these actions may be done by the senses, by the motion of corporeal spirits, and by material impressions upon them; without being constrain'd to resort to an immaterial principle, which must furnish birds with reason and discourse. In which, it is not necessary for my purpose, to determine precisely every step by which these actions are performed, and to settle the rigorous truth of them: but, leaving that to those who shall take pains to deliver the history of their nature, I will content my self with the possibility and probability of my conjectures. The first of which qualities I am obliged to make plain; but the latter concerns this Treatise no more, than it would do a man to enquire anxiously into the particulars of what it is that a beast is doing, whiles, looking upon it at a great distance, he perceiv's plainly that it moves it self: and his errand is, but to be assured whether it be alive or dead; which the moving of it self in common sufficiently demonstrates, without descending into a particular search of what his motions are.

But let us come to the matter. First, I conceive no man will make any difficulty in allowing, that it is the temper of the blood and spirits in Birds (brought therto by the quality of their food, and the season of the year), which makes them couple with one another; and not any aim or desire of having young ones, that occasions this action in them. Then it follows, that the Hens eggs will encrease in her belly; and, when they grow big, they cannot choose but be troublesome unto her: and therefore, must of necessity breed in her an inclination to rest in some soft place, and to be rid of them. And, as we see a Dog or a Cat, press'd by nature, searches about to find a convenient place to disburthen themselves in, not only of their young ones, but even of their excrements; so do Birds: whose eggs within them making them heavy and unfit to flie, they begin to sit much and are pleas'd in a soft and warm place; and thereupon are delighted with straws and mosse and other gentle sub-

G g

stances,



stances, and so carry them to their sitting place. Which that they do not by design is evident by the manner of it: for, when they have met with a straw or other fit material, they flie not with it directly to their nest, but first to a bough of some tree, or to the top of a house; and there they hop and dance a while with it in their beaks, and from thence skip to another place, where they entertain themselves in like manner, and at last, they get to their nest. Where, if the straws should lie confusedly, their ends would prick and hurt them; and therefore they turn and alter their positions till they lie smooth: which we that look upon the effect, and compare them with our performing of like actions (if we had occasion), may call a judicious ordering of them; whereas in them, it is nothing but removing such things as press upon their sense, till they cause them no more pain or uneasiness.

Their plaistering of their nests may be attributed to the great heat reigning in them at that time; which makes them still be dabling in moist clay, and water, and gravel, (without which, all birds will soon grow sick, blind, and at length die): which (for the coolness of it) they bring home to their nests, in their beaks and upon their feet; and, when it grows dry and consequently troublesome to them, they wipe it off, and rub their dirty parts upon the place where they use to sit, and then flie for more to refresh themselves with.

Out of all which actions (set on foot by the wise orderer of nature, to compass a remote end, quite different from the immediate end that every one of them is done for) there results a fit and convenient place for these little builders (that know not what they do, whiles they build themselves houses) to lie and lay their eggs in: which the next year, when the like occasion occurs, they build again; peradventure then, as much through memory of the former, as upon their temper and other circumstances, moving their fancy, so as we have set down.

In like manner, that, whiles the *Halcyon* layes and hatches her eggs, the Sea is calm, needs no more be attributed to the wisdom and providence of that bird, in choosing a fit season, than to any good nature or discourse in that rouling and mercilefs



less Element; as though it had a pious care of preserving the eggs committed to his trust: no such supplements are requisite to be added to the distributions of nature; who hath set material causes on foot to produce a conjuncture of both those effects, at the same period of time, for the propagation of this animal's *species*.

In fine, both the time and place of the *Halcyon's* breeding, and the manner and order and season of all birds making their nests, proceeds from secret motions: which require great observing and attention to understand them; and serve for directions to every bird, according to her kind, to make her nest fittest for her use. Which secret motions, we cannot doubt but are material ones, and arise out of the constitution and temper of their bodies and spirits; which, in like circumstances, are alike in them all. for all the birds of one kind make their nests exactly alike. Which they would not do, if this work proceeded from reason in them, and were govern'd by their own election and design: as we see it happen among men upon all occasions, either of building houses, or of making clothes, or of what action soever is guided by their reason governing their fantasy; in all which we see so great variety and inconstancy.

Therefore, this invariability in the birds operations must proceed from a higher intellect, that hath determinately and precisely ordered a complex or assembly of sundry causes, to meet infallibly and by necessity, for the production of an effect he hath designed: and so, the birds are but material instruments to perform, without their knowledg or reflexion, a superiour reason's counsels; even as in a clock, that is composed of several pieces and wheels, all the parts conspire to give notice of the several effluxes and periods of time, which the maker hath order'd it for.

And, though this be a work of reason and discourse in him that set it together; yet the instrumental performance of it depends meerly of local motion, and the revolutions of bodies, so orderly proportion'd to one another that their effects cannot fail, when once the engine is wound up. In like manner then, the Bird is the engine of the Artificer, infinitely more perfect and knowing and dexterous than a poor clock-



maker : and the plummets which make it go, are the row and order of causes chain'd together ; which, by the design of the supream workman, bring to pass such effects as we see in the building of their nests, and in doing such other actions, as may be compared to the strikings of the clock, and the ringing of the alarm at due times.

And as that King of *China*, upon his first seeing a Watch, thought it a living and judicious creature, because it moved so regularly of it self ; and believ'd it to be dead, when it was run out : till the opening and winding it up discover'd to him the artifice of it. So any man may be excused, that looking upon these strange actions and this admirable œconomy of some living creatures, should believe them endew'd with reason ; till he have well reflected upon every particular circumstance of their nature and operations : for then he will discern how these are but material instruments of a rational agent, working by them ; from whose orderly prescriptions they have not power to swerve in the least circumstance that is. Every one of which, consider'd singly by it self, hath a face of no more difficulty, than that (for example) an Engineer should so order his matters, that a Mine should be ready to play exactly at such an hour ; by leaving such a proportion of kindled match hanging out of one of the barrels of powder, whiles, in the mean time, he either sleeps or attends to something else.

And, when you have once gain'd thus much of your self, to agree to an orderly course and generation of any single effect, by the power of a material cause working in it ; raise but your discourse a strain higher, and look with reverence and duty up the Immensity of That Provident Architect, out of whose hands these master-pieces issue, and to whom it is as easy to make a chain of causes, of a thousand or million of links, as to make one link alone : and then you will no longer stick at allowing the whole œconomy of those actions, to be nothing else but a production of material effects, by a due ranging and ordering of material causes.

But, let us return to our theme. As we see that milk coming into the breasts of live-bearing female creatures, when they grow very big, heats and makes them seek the mouths



mouths of their young ones, to disburthen and cool them: so, the carriage and bigness of the Eggs heats exceedingly the breasts and bodies of the Birds; and this causes them to be still rubbing of their breasts against the sides of the nests (wherto their unwieldiness then confines them very much) and with their Beaks to be still picking their Feathers, which being then apt to fall off and mew (as we see the hair of women with child is apt to shed) it happens that, by then they are ready to lay their Eggs, they have a soft bed of their own Feathers made in their Nests, over their courser mattresses of straws they first brought thither. And then, the Eggs powerful attracting of the annoying heat from the Hens breast (whose imbibing of the warmth, and stone-like shell, cannot choose but cool her much) invites her to sit constantly upon them; till sitting hatches them. And 'tis evident, that this sitting must proceed from their temper at that time, or from some other immediate cause which works that effect; and not from a judgment that doth it for a remote end: for, house-wives tells us, that, at such a season, their Hens will be sitting in every convenient place they come to, as though they had Eggs to hatch, when never a one is under them; so as it seems, that at such time, there is some inconvenience in their bodies, which by sitting is eased.

When the Chickens are hatched, what wonder is it, if the little cryings of tender creatures, of a like nature and language with their Dam, move those affections or passions in her bosome, which causes her to feed them; and so defend and breed them, till they be able to shift for themselves? For all this there needs no discourse or reason; but only the motion of the blood about the heart (which we have determin'd to be passion) stir'd by the young ones chirpings, so as may carry them to those actions, which by nature (the supreme intellect) are order'd for their preservation. Wherin the Birds (as we have already said) are but passive instruments, and know not why they do those actions: but do them they must, whenever such and such objects (which infallibly work in their due times) make such and such impressions upon their fantasies; like the allarum that necessarily strikes, when



the hand of the Dial comes to such a point, or the Gun-powder, that necessarily makes a ruine and breach in the wall, when the burning of the match reaches to it.

Now, this love in the Dam, growing by little and little wearisome and troublesome to her, and not being able to supply their encreased needs, which they grow every day stronger to provide for of themselves; the strait commerce begins to die on both sides: and by these degrees the Dam leaves her young ones to their own conduct.

And thus you see, how this long *series* of actions may have orderly causes, made and chain'd together, by him that knew what was fitting for the work, he went about. Of which, though 'tis likely I have missed the right ones (as it cannot choose but happen in all disquisitions, where one is the first to break the Ice, and so slenderly informed of the particular circumstances of the matter in question, as I profess to be in this); yet I conceive, this discourse plainly shews, that he, who hath done more, than we are able to comprehend and understand, may have set causes sufficient for all these effects, in a better order and in completer ranks, than those we have here expressed: and yet in them, so coarsely hew'd out, appears a possibility of having the work done by corporeal agents. Surely, it were very well worth the while, for some curious and judicious person to observe carefully and often the several steps of nature in this progress: for I am strongly perswaded, that, by such industry, we might in time arrive to very particular knowledge of the immediate and precise causes, that work all these effects. And, I conceive, that such observation needs not be very troublesome; as not requiring any great variety of creatures to institute it upon: for, by marking carefully all that passes among our home-bred Hens, I believe it were easy to guess very nearly at all the rest.



## C H A P. XXXVIII.

*Of Prescience of future events, Providences, the knowing of things never seen before; and such other actions, observed in some living creatures: which seem to be even above the reason that is in man himself.*

**T**He fourth and last kind of actions, which we may with astonishment observ among beasts, I conceive will avail little to infer, that the creatures which do them, are endew'd with reason and understanding: for such they are, as, if we should admit that, yet we should still be as far to seek for the causes, whence they proceed. What should move a Lamb to tremble at the first sight of a Woolf? or a Hen at a Kite never before seen? neither the grimest Mastiff, nor the biggest Owl will at all affright them.

Why beasts  
are afraid of  
men.

That which, in the ordinary course of nature causes beasts to be afraid of men, or of other beasts, is the hurt and evil they receive from them: which coming into their fantasie, together with the *Idea* of him that did it, is also lodg'd together with it in the memory; from whence they come link'd or glew'd together, when ever the stroke of any new object calls either of them back into the fantasie. This is confirm'd by the tameness of the birds and beasts, which the first discoverers of Islands not inhabited by men, found in those they met with there. Their stories tell us, that, at their first arrival upon those coasts, (where it seems men had never been) the birds would not flie away, but suffer'd the Mariners to take them in their hands; nor the beasts, which with us are wild, would run from them; but, their discourteous guests used them so hardly, as they soon chang'd their confidence into distrust and aversion; and by little and little, grew by their commerce with men, and receiving injuries from them, to be as wild, as any of the like kind in our parts.

From the Dams and Sires, this apprehension and fear at  
G g 4 the



the sight of men, so deeply rooted in them, is doubtless transmitted to their young ones; for it proceeds out of the disposition of the body, and the passion immediately made in the heart; and that is as truly a material motion as any whatever can be, and must have settled material instruments fitted to it, if it be constant, as well as any other natural operation whatever. And this passion of the heart proceeds again from a perpetual connexion of the two objects in the memory: which, being a perpetually constant thing, is as true a quality of that beasts brain in whom it is, as the being of a quick or dull apprehension, or apt to know one kind of meat from another (which is natural to the whole *species*); or any other quality whatever, residing in that beast.

2.  
How some  
qualities  
caul'd at first  
by chance,  
in beasts, may  
pass by gene-  
ration to the  
whole off-  
spring,

Wherefore 'tis no wonder, that it passes by generation to the off-spring (which is a thing so common, even in mankind, as there can be no doubt of it) and is at first made by a violent cause, that greatly alters the body: and consequently the seed must be imbew'd with a like disposition; and so it passes together with the nature of the Sire, or of the Dam, into the brood. From hence proceeds, that children love the same meats and exercises, that their Fathers and Mothers were affected with; and fear the like harms.

This is the reason, why a Grand-child of my Lord of *Dorset* (whose honour'd name must never be mention'd by me, without a particular respect, and humble acknowledgment of the noble and steady friendship, he hath ever been pleas'd to honour me with) was always extremely sick, if but the Nurse did eat any Capers (against which my Lord's antipathy is famous) while she gave suck to that pretty infant. The Children of great Mathematicians, who have been used to busie their fantasies continually with figures and proportions, have been oftentimes observ'd to have a natural bent to those Sciences. And we may note, that, even in particular gestures, and in little singularities in familiar conversation, children will oftentimes resemble their Parents; as well as in the lineaments of their faces. The young ones of excellent setting Dogs will have a notable aptitude to that exercise; and may be taught with  
half



half the pains, that their sire or dam was; if they were chosen out of a race of Spaniels not trained to setting. All which effects can proceed from no other cause, but (as we have touch'd already) that the fantasy of the parent alters the temper and disposition of his body and seed, according as it self is temper'd and disposed; and consequently, such a creature must be made of it, as retains the same qualities: as 'tis said, that sufficient Tartar, put at the root of a tree, will make the fruit have a winy taste.

But, nothing confirms this so much, as certain notable accidents; wherof though every one in particular would seem incredible, yet the number of them, and the weight of the reporters (who are the witnesses) cannot choose but purchase a general credit to the kind of them. These accidents are, that, out of some strong imagination of the parents, but especially of the mother in the time of conception, the children draw such main differences, as were incredible, if the testifying authority were not so great: but, being true, they convince beyond all question the truth we have proposed, of the parents imagination working upon, and making an impression in the seed, wherof children or young ones of their kind are made. Some children of white parents are reported to have been black, upon occasion of a Black-moors picture too much in the mothers eye. Others are said to have been born with their skins all hairy; out of the sight of *St John Baptist's* picture as he was in the desert, or of some other hairy image. Another child is famed to have been born disformed, so as Devils are painted; because the father was in a Devils habit when he got the child.

There was a Lady, a kinswoman of mine, who used much to wear black patches upon her face (as was the fashion among young women); which I, to put her from, used to tell her in jest, that the next child she should go with, whiles the sollicitude and care of those patches was so strong in her fantasy, would come into the world with a great black spot in the midst of its forehead: and this apprehension was so lively in her imagination at the time she proved with child, that her daughter was born mark'd just as the mother had fancied; which

3.  
How the parents fantasy oftentimes works strange effects in their issue.

there



there are at hand witnesses enough to confirm, but non more pregnant, than the young Lady her self, upon whom the mark is yet remaining. Among other creatures, 'tis said, that a Hen hatch'd a Chicken with a Kites bill; because she was frighted with a Kite, whiles the Cock was treading her. The story of *Jacob's* Sheep is known to-all; and some write, that the painting of beautiful colour'd pigeons in a Dove-house will make the following race become like them: and in Authors, store of such examples may be found.

To give a reasonable and fully satisfying cause of this great effect, I confess, is very difficult; since, for the most part, the parents seed is made long time before the accoupling of the male and female: and though it were not, we should be mainly to seek for a rational ground to discourse in particular, upon it. Yet, not to leav our Reader without a hint which way to drive his inquisition, we will note thus much; that *Aristotle* and other natural Philosophers and Physicians affirm, that, in some persons, the passion is so great in the time of their accoupling, that, for the present, it quite bereavs them of the use of reason, and they are for the while in a kind of short fit of an Epilepsie. By which 'tis manifest, that abundance of animal spirits then part from the head, and descend into those parts which are the instruments of generation. Wherefore, if there be abundance of *specieses* of any one kind of object then strong in the imagination, it must of necessity be carryed down together with the spirits into the seed: and by consequence, when the seed infected with this nature begins to separate and distribute it self, to the forming of the several parts of the *Embryon*; the spirits, which resort into the brain of the child (as to their proper Element) and from thence finish all the outward cast of its body (as we have above described) somtimes happen to fill certain places of the childs body with the infection and tincture of this object; and that according to the impression with which they were in the mothers fantasy: for so, we have said, that things which come together into the fantasy naturally stick together in the animal spirits. The hairiness therefore will be occasioned in those parts, where the Mother fantasied it to be:



be : the colour likewise, and such extancies or defects, as may any way proceed from such a cause, will happen to be in those parts, in which they were fancied. And this is as far, as is fit to wade into this point; for so general a discourse as ours is, and more, than was necessary for our turn; to the serving wherof, the verity of the fact only, and not the knowledg of the cause, was required : for we were to shew no more, but that the apprehensions of the parents may descend to the children.

Out of this discourse, the reason appears, why beasts have an aversion from those who use to do them harm : and why this aversion descends from the old ones to their brood; though it should never have hapned that they had formerly encountred with, what, at the first sight, they fly from and avoid.

But yet the reason appears not, why (for example) a Sheep in *England* (where there are no Wolves bred, nor have been these many ages) should be afraid and tremble at sight of a Wolf; since neither he, nor his dam or sire, nor theis, in multitudes of generations, ever saw a Wolf, or receiv'd hurt by any. In like manner, how should a tame Weasell, brought into *England* from *Ireland* (where there are no poisonous creatures), be afraid of a Toad as soon as he sees one? Neither he, nor any of his race, ever had any impressions of following harm made upon their fantasies; and as little can a Lion receive hurt from a household Cock : therfore we must seek the reasons of these and such like Antipathies a little further; and we shall find them hanging upon the same string, with Sympathies proportionable to them.

Let us go by degrees: We daily see, that Dogs will have an aversion from Glovers, that make their ware of Dogs skins: they will bark at, and be churlish to them, and not endure to come near them; though they never saw them before. The like hatred they will express to the Dog-killers in the time of the Plague, and to those that flea Dogs. I have known of a man that used to be imploid in such affairs, who, passing somtimes over the grounds near my Mothers house (for he dwelt at a Village not far off), the Dogs

would

4.  
Of antipa-  
thies.



would wind him at a very great distance, and all run furiously out the way he was, and fiercely fall upon him; which made him go always well provided for them: and yet he has been sometimes hard put to it, by the fierce Mastiffs there, had it not been for some of the Servants coming in to his rescue; who, by the frequent hapning of such accidents, were warned to look out when they observ'd so great commotion and fury in the dogs, and yet perceiv'd no present cause for it. Warreners observe, that vermin will hardly come into a trap wherein another of their kind hath been lately kill'd: and the like happens in Mouse-traps, into which no Mouse will come to take the bait, if a Mouse or two have already been kill'd in't; unless it be made very clean, so that no scent of them remain upon the Trap, which can hardly be done on the sudden, otherwise than by fire.

'Tis evident, that these effects are to be refer'd to an activity of the object upon the sense: for, some smell of the skins, or of the dead dogs, or of the vermine, or of the Mice, cannot choose but remain upon the Men and Traps; which, being alter'd from their due nature and temper, must needs offend them. Their conformity, on the one side, (for something of the canine nature remains) makes them have easy ingress into them; and so they presently make a deep impression: but, on the other side, their distemper from what they should be makes the impression repugnant to their nature, and be disliked by them; and to affect them worse, than if they were of other creatures, that had no conformity with them. As we may observe, that stinks offend us more, when they are accompanied with some weak perfume, than if they set upon us single; for the perfume gets the stink easier admittance into our sense: and in like manner, 'tis said that poisons are more dangerous, when they are mingled with a cordial that is not able to resist them; for it serves to convey them to the heart, though it be not able to overcome their malignity.

From hence then it follows, that, if any beast or bird prey upon some of another kind, there will be some smell about them, exceedingly noisom to all others of that kind:  
and



and, not only to beasts of that same kind, but (for the same reason) even to others likewise, that have a correspondence and agreement of temper and constitution with that kind of beast, whose hurt is the original cause of this aversion. Which being assented to, the same reason holds to make those creatures, whose constitutions and tempers consist of things repugnant and odious to one another, be at perpetual enmity, and fly from one another at the first sight, or at least, the sufferer from the more active creature: as we see among those men, whose unhappy trade and continual exercise it is to empty Jakeses, such horrid stinks are by time grown so conformable to their nature, as a strong perfume will as much offend them, and make them, as sick as such stinks would do another man bred up among perfumes; and a Cordial to their spirits is some noysome smell, that would almost poison another man. And thus, if in the breach of the Wolf or the steam coming from his body, any quality be offensive to the Lamb (as it may very well be, where there is so great a contrariety of natures) it is not strange, that, at the first sight and approach of him, he should be distemper'd and flee from him; as one fighting Cock will do from another that hath eaten Garlike: and the same happens between the Weasel and the Toad, the Lion and the Cock, the Toad and the Spider; and several other creatures, of whom like enmities are reported.

All which are caus'd in them, not by secret instincts, and Antipathies, and Sympathies, wherof we can give no account; (with the bare sound of which words most men pay themselves, without examining what they mean):- but by downright material qualities, that are of contrary natures, (as fire and water are); and are either begotten in them in their original constitution, or implanted afterwards by their continual food, which, nourishing them, changes their constitution to its complexion. And, I am perswaded, this would go so far, that, if one man were nourish'd continually with such meat (and greedily affected it) which another had aversion from; there would naturally follow much dislike between them: unless some superiour regard should master this



this aversion of the sense. And I remember to have seen two notable examples of it. One, in *Spain*, of a Gentleman that had a horreur to Garlike, who (though he was very subject to the impressions of beauty) could never wean himself from an aversion he had settled in him to a very handsome woman, that used to eat much Garlike; though, to win him, she forbore the use of that meat, which to her was the most savoury of all others. And the like I knew in *England* between two, whereof one extremely loved Cheese, and the other as much hated it, and would fall into a strange agony, and be reduced (one would think) to the point of death, if by inadvertency or others trial of him, he had swallow'd never so little of what the other would have quitted all meats else to live upon.

And, not only such aversions, as spring from differences of complexions in the constitutions of several animals, cause these effects of fear and trembling, and flying from those that make such impressions; but even the seeing them angry and in fury doth the like: for, such passions alters the spirits; and they, issuing from the body of the animal in passion, cannot choose but be receiv'd by another in a different manner, than if they were of another temper. Then, if the one kind be agreeable to their nature, the other must needs be displeasing. And this may be the reason, why Bees never sting such as are of a milde and gentle disposition; and will never agree with others, that are of a froward and angry nature: And the same one may observe among Dogs. And peradventure, a mans fantasie may be raised to such a height of fury, that the fiercest beast may be afraid to look on him, and cannot endure that those mastering spirits, which stream out of the mans eye, should come into his; so much they distemper his fantasie: and therefore he will turn away from the man, and avoid him. Which discourse may be confirm'd, by sundry examples of Lions and Bears, that have run from angry and confident men; and the like. Since then, a man, that in his naturall hew, gives no distast, so much affrights fiercest beasts, when he puts on his threatening looks; 'tis no wonder that beasts, of a milder and softer nature, should have fear of him settled in them,



them, when they never saw him otherwise than angry, and working mischief to them, And, since their brood receive from their parents a nature easily moved to fear or anger, by the sight of what moved them; 'tis not strange, that, at the first sight, they should tremble or swell, according as the inward motion of the spirits affords:

Now, if this hath render'd the Birds in the wild Islands afraid of men, who otherwise would be indifferent to them; 'tis no marvel to see more violent effects in the Lambs aversion from the Wolf, or in the Larks from the Hobbey: since they peradventure have, over and above the hurt they use to do them, a deformity in their constitutions; and therefore, though a Lark will flie, as well from a man as from a Hobbey, yet because there is one cause more for his dislike against the Hobbey than against the man (namely the deformity of their constitutions), he will flie into the mans hand, to avoid the Hawks talons.

To some of these causes all Antipathies may be reduced: and the like reason may be given for the Sympathies we see between some creatures. The little corporeities which issue from the one have such a conformity with the temper of the other, that it is thereby moved to joyn it self to the body from whence they flow, and affects union with it in that way, as it receives the impression. If the smell please it, the beast will always be smelling at it: if the tast, nothing shall hinder it from feeding upon it, when it can reach it. The Fishermen upon the bank over against *Newfound Land* report, that there flocks about them a kind of Bird, so greedy of the Fishes livers, which they take there, as that, to come at and feed on them, they will suffer the men to take them in their hands; and not flie away, as long as any of their desired meat is in their eye: whence the *French-men* that fish there, call them *Happe Foyes*. The like power a certain Worm has with *Nightingales*.

And thus you see, how they are strong impressions upon sense, and not any discourse of reason, that govern Beasts in their actions. For, if their avoiding men did proceed from any sagacity in their nature, surely they would exercise it when they see

5.  
Of Sympa-  
thies.



see that, for a bit of meat, they incur their destruction: and yet, neither the examples of their fellows kill'd before their eyes in the same pursuit, nor the blows which themselves do feel, can serve them for warning, where the sense is so strongly affected; but as soon as the blow that removed them is passed, (if it miss killing or laming them), and they be gotten on wing again, they'll return to their prey, as eagerly and as confidently as if nothing were there to hinder them.

6.  
That the Antipathy of Beasts towards one another may be taken away by affuefaction.

This then being the true reason of all Sympathy and Antipathy; we cannot admit that any Beasts should love or hate one another, for any other cause, than some of those we have touched. All which are reduced to local motion, and to material application of bodies of one nature, to bodies of another; and are as well transmitted to their young ones, as begotten in themselves.

And as the satisfying of their sense is more prevalent in the *Happe Foyes*, than the fear which from other grounds is begotten in their fantasy; and so makes them approach to what the other would drive them from: In like manner, any aversion of the fantasy may be master'd, not only by a more powerful agent upon the present sense; but also by affuefaction, and bringing into the fantasy, with pleasing circumstances, that object which before was displeasing and affrightful to it. As we see that all sorts of Beasts or Birds, if they be taken young may be tamed and will live quietly together. Dogs that are used to hunt and kill Deer, will live friendly with one that is bred with them; and that Fawn, which otherwise would have bin afraid of them, by such education grows confident and plays boldly with them. Of which we can no longer remain in doubt, if we will believe the story of a Tyger (accounted the cruellest beast of all others); who, being shut up with a Deer, that had bin bred with him from a Kid and from his being a Whelp, and no meat given him, used means to break prison when he was half starved, rather than he would hurt his familiar friend. You will not suspect, that it was a moral consideration which made him so kind: but the Deer had never come into his fantasy



tasie accompanied with other circumstances, than of play or of warmth ; and therefore hunger ( which calls only the *species* of meat out of the memory into the fantasie ) would never bring the Deer thither, for remedy of that passion.

And that which often happens to those men, in whom the fantasie only works, is not much unlike to this : among whom I have seen some frentick persons, that, if they be perswaded they are tyed and cannot stir from the place where they are, will lye still and make great complaints for their imprisonment ; and not go a step to reach any meat or drink that should lie in sight near them, though they were never so much pressed with hunger or thirst. The reason is evident ; for, the apprehension of being tyed is so strong in their fantasie, that their fantasie can send no spirits into other parts of their body, wherby to cause motion.

And thus the Deer was beholding to the Tyger's fantasie, not to his discourse of moral honesty, for his life. The like of this Tyger and Deer is to be seen every day in the *Tower of London* : where, a little Dog, that was bred with a Lion from his birth, is so familiar and bold with him, that they not only sleep together, but somtimes the Dog will be angry with him, and bite him ; which the Lion never resents from him, though any other Dog that is put to him he presently tears in pieces.

And thus we plainly see, how it comes about, that beasts may have strange aversions from things, which are of an annoying or destructive nature to them, even at the first sight of them ; and again, may have great likings of other things, in a manner contrary to their nature : without needing to allow them reason, wherby to discourse and judge what is hurtful to them ; or to instruct the Tyger we have spoken of, or *Androdus's* Lion, the duties of friendship and gratitude.

The Longing marks which are oftentimes seen in children, and remain with them all their life, seem to be an offspring of the same root or cause ; but in truth, they proceed from another, though of kin to this : for, the operation of the seed is pass'd, when these Longing marks are imprinted,

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the

7.  
Of Longing  
marks seen in  
children.



the child being then already form'd and quickn'd: and they seem to be made suddenly, as by the print of a seal. Therefore, to render the cause of them; let us consider another sympathy, which is more plain and common. We see that the laughing of one man will set another on laughing, that sees him laugh; though he know not the cause, why the first man laughs; and the like we see in yawning and stretching, which breed the like effect in the looker on. I have heard of a man, that, seeing a roasted Pig, after our English fashion with the mouth gaping, could not shut his own mouth, as long as he look'd upon the Pigs: and of another, that, when he saw any man make a certain motion with his hand, could not choose but he must make the same; so that, being a Tyler by his Trade, and having one hand imploy'd with holding his tools, while he held himself with the other upon the eav's of a house, he was mending, a man standing below on the ground made that sign or motion to him wherupon he quited his holdfast to imitate that motion, and fell down, in danger of breaking his neck.

All these effects proceed out of the action of the seen object, upon the fantasie of the looker on, which, making the picture or likeness of its own action in the others fantasie, makes his spirits run to the same parts; and consequently, move the same members, that is, do the same actions. And hence it is, that, when we hear one speak with love and tenderness of an absent person, we are also inclined to love that person, though we never saw nor heard of him before; and that whatever a good Oratour delivers well (that is, with a semblance of passion agreeable to his words) raises, of its own nature, like affection in the hearers: and that generally men learn and imitate (without design) the customs and manners of the company, they much haunt.

To apply this to our intent, 'tis easie to conceive, that, although the child in the mothers wombe can neither see nor hear what the mother doth; nevertheless there cannot pass any great or violent motion in the mothers body, wherof some effect doth not reach to the child, which is then one continueate piece with her: and the proper effect of motion or trembling



trembling in one body, being to produce a like motion or trembling in another, (as we see in that ordinary example of tuned strings, wherof one is moved at the striking of the other, by reason of the stroke given to the air, which, finding a movable easily moved with a motion of the same tenour, communicates motion to it); it follows, that the fantasie of the child being as it were well tuned to the fantasie of the mother, and the mothers fantasie making a special and very quick motion in her own whole body, (as we see sudden passions do), this motion or trembling of the mother must needs cause the like motion and trembling in the child, even to the very swiftness of the mothers motion. Now, as we see, when one blushes the blood comes into his face, so the blood runs in the mother to a certain place, where she is stricken by the thing long'd for: and the like hap'ning to the child, the violence of that sudden motion dyes the mark or print of the thing in the tender skin of it; the blood in some measure piercing the skin, and not returning wholly into its natural course: which effect is not permanent in the mother, because her skin, being harder, doth not receive the blood into it; but sends it back again, without receiving a tincture from it.

Far more easie is it, to discover the secret cause of many antipathies or sympathies, which are seen in children, and endure with them, the greatest part, if not the whole term, of their life, without any apparent ground for them. As, some do not love Cheese, others Garlick, others Ducks; others divers other kinds of meat, which their parents loved well: and yet, in token that this aversion is natural to them, and not arising from some dislike accidentally taken and imprinted in their fantasie; they will be much harmed, if they chance to eat any such meat, though, by the much disguising it, they neither know, nor so much as suspect they have done so. The story of the Lady *Hennage* (who was of the Bed-chamber to the late Queen *Elizabeth*), that had her cheek blister'd by laying a Rose upon it, whiles she was asleep; to try if her antipathy against that flower were so great, as she used to pretend, is famous in the Court of *England*. A Kinsman of mine, whiles

8.  
Why divers  
men hate some  
certain meats,  
and particu-  
larly Cheese;



he was a Child, had like to have died of drought, before his Nurse came to understand, that he had an antipathy against Beer or Wine: till the tender nature in him, before he could speak, taught him to make earnest signs for water, that by accident he saw; the greedy drinking of which cured presently his long languishing and pining sickness. And such examples are very frequent.

The cause of these effects many times is, that their mothers, (upon their first suppression of their usual evacuations, by reason of their being with child) took some strong dislike to such things: their stomachs being then oppressed by unnatural humors, which overflow their bodies upon such retentions and make them oftentimes sick and prone to vomiting (especially in the mornings, whiles they are fasting) and sometimes to desire earnestly (which they call longing) to feed upon some unwholsome, as well as some particular wholsome things; and other whiles, to take aversion against meats, which at other seasons they affected well. Now, the child being nourished by the so-imbued blood of the mother; no wonder if it takes affections or dislikes, conformable to those which at that present reign in the mother. Which, for the most part, use to be purged away, or are overwhelmed by the mastering qualities of better aliments succeeding; but if, by some mischance, they become too much grafted in the childs stomach, or in some other part through which the masse of blood must pass, then the child gets an aversion from those meats: and we often see, that persons retain a strong conversion to such meats or drinks, as their mothers affected much or longed for whiles they bred them.

And thus we will leave this particular; adding only one note, why there are more persons, generally, who have antipathy against Cheese, than against any one sort of meat besides whatever. A principal reason of which symptome (where the precedent one hath not place) I conceive to be that their nurses proved with child, whiles they gave them suck: for I have by experience found it to have been so, in as many as I have made inquiry into. And it is very conformable to reason: for the nurses milk crudling in her brest upon her breeding of child, and becoming very offensive to the childs tender stomach, (whose being sick, obliges,



obliges the Parents to change the Nurse, though peradventure they know nothing of the true reason that makes her milk unnatural) he hath a dislike of Cheese (which is strong curdled milk) ever after settled in him, as people, that have once surfeited violently of any meat, seldom arrive to brock it again.

Now, as concerning those animals who lay up in store for winter, and seem therein to exercise a rational providence: who sees not, that it is the same humour, which moves rich misers to heap up wealth, even at their last gasp; when they have no child nor friend to give it to, nor think of making any body their heirs? Which actions, because they have no reason in them, are to be imputed to the passion or motion of the material appetite. In the doing of them these steps may be observed; First the Object, presenting itself to the eye, provokes love and desire of it; especially if it be joyn'd with the memory of former want: then, this desire stirs up the animal (after he hath fed himself) to gather into [the place of his chief residence, as much of that desired object, as he meets with; and when ever his hunger returning brings back into his fantasy the memory of his meat, it being joyn'd with the memory of that place (if he be absent from it) he presently repairs thither for relief of what presseth him; (and thus Dogs, when they are hungry, rake for bones they had hidden when their bellies were full.) Now, if this food, gathered by such providence (which is nothing else but the conformity of it, working upon him by his sense) and layed up in the place where the owner of it resides, (as the Corn is, which the Ants gather in Summer) be easily portable; he will carry it abroad with him, the first time he stirs after a long keeping in: for then nothing works so powerfully in his fantasy, as his store; and he will not easily part from it, though other circumstances invite him abroad. From hence it proceeds, that, when a fair day comes after long foul weather, the Ants, who all that while kept close in their Dens with their Corn lying by them, then come abroad in the Sun, and carry their Grain along with them: or peradventure it happens, because the precedent wet weather hath made it grow hot, or musty, or other-

9.  
Concerning  
the provi-  
dence of *Ants*,  
in laying up  
store for win-  
ter.



wife offensive within; and therefore they carry it out, as soon as themselves dare peep abroad, which is, when the fair weather and heat of the day invites them out into the open air: and, before night, that they return into their holes, the offensive vapours of the corn are exhaled and dryd up, and move their fantasies no longer to aversion; wherupon they carry it back again, having then nothing but their long contracted love to it, to work upon them. The like wherof men doing by discourse, to air their corn and keep it sweet, and the same effect following therein; they will presently have it, that this is done by the Ants for the same reason, and by design. Then, the moisture of the earth swelling the grain, and consequently, making it begin to shoot at the ends, (as we declared, when we spoke of the generation of Plants, and as we see in the moistning of Corn to make Malt of it) those little creatures, finding that part of it more tender and juicy, than the rest, nibble upon it there, and feed themselves first with that, which consequently hinders the growth of the corn. And here again, men will contend that this must be done by providence and discourse; to prevent, that their store should not grow out of their reach and changing nature, become useless to them in their need.

To.  
Concerning  
the Foreknow-  
ing of Beasts.

To conclude, the Foreknowing of Beasts is nothing else, but their timely receiving impressions, from the first degrees of mutations in things without them: which degrees are almost imperceptible to us, because our fantasies & spirits have otherwise such violent agitations, more than theirs; which hinder them from discerning gentle impressions upon them. If you be at Sea, after a long calm, a while before a gale blows to fill your Sails, or to be discernible by your sense in quality of wind, you shall perceive the Sea begin to wrinkle his smooth face that way the wind will come: which is so infallible a sign that a gale will come from that coast, as mariners immediately fall to trimming their sailes accordingly; and usually, before they can have done, the wind is with them; shall we therefore say that the Sea hath a providence, to foresee which way the wind will blow? or that the corns upon our toes, or calluses, or broken bones, or joints that have been dislocated, have discourse & can fore-  
tell



tell the weather? 'Tis nothing else, but that the wind rising by degrees, the smooth Sea is capable of a change by it, before we can feel it: and that the Air, being changed by the forerunners of worse weather, works upon the crashest parts of our body, when the others feel not so small a change. So beasts are more sensible, than we (for they have less to distract them) of the first degrees of a changing weather: and that mutation of the air without them makes some change within them, which they express by some outward actions or gestures.

Now, they who observe how such mutations and actions are constantly in them, before such or such weather, think they know beforehand, that rain (for example) or wind, or drought is coming; according to the several signs they have mark'd in them. Which proceeds out of the narrowness of their discourse; that makes them resort to the same causes, when ever they meet with like effects: and so they conceive, that things must needs pass in Beasts, after the same tenour, as they do in men. And this is a general and main error, running through all the conceptions of mankind, (unless great heed be taken to prevent it, that, what subject soever they speculate on, whether it be of substances that have a superiour nature to theirs, or of creatures inferiour to them; they are still apt to bring them to their own standard, and to frame such conceptions of them, as they would do of themselves: As, when they will have Angels discourse, and move, and be in place, in such sort as is natural to men; or when they will have beasts ratiocinate and understand, upon their observing some orderly actions perform'd by them, which in men would proceed from discourse and reason. And this dangerous Rock (against which many fine conceptions suffer shipwrack) whoever studies truth must have a main caution to avoid.

*Sed nos immensum spatium confecimus aequor:  
Et jam tempus equum fumantia solvere colla.*





# CONCLVSION.

**T**Hus at last ( by Gods assistance ) we have climb'd up to the top of the Hill; from whence looking down over the whole region of bodies, we may delight our selves, with seeing what a height the weary steps we ascended by have brought us to. 'Tis true, the path we have walk'd in, is of late so untrodden, and so overgrown with briars, as it hath not been without much labour, that we have made our way through. And peradventure, it may seem toilsome to others to follow us; especially such as are not much enured to like journeys: but, I hope, the fruit, which both we and they are now arrived to gather of our pains, in this general view we have taken of the Empire of matter, and of corporeal agents, is such, as none of us hath reason to be ill satisfied with the imploying of them. For, what can more powerfully delight, or more nobly entertain an understanding soul, than the search and discovery of those works of nature; which being in their effects so plainly exposed to our eyes, are in their causes so abstruse and hidden from our comprehension, as (through despair of success) they deter most men from enquiring into them?

And



And I am perswaded, that, by this summary discourse (short indeed, in regard of so large a scope, how ever my lame expressions may peradventure make it appear tedious), it appears evidently, that none of natures greatest secrets, wherof our senses give us notice in the effects, are so overshadowed with an impenetrable veil, but that the diligent and wary hand of reason might unmask and shew them to us, in their naked and genuine forms, and delight us with the contemplation of their native beauties: if we had as much care and constancy in the pursuit of them, as we daily see men have in heaping up wealth, or in striving to satisfy their boundless ambitions, or in making their senses swim in the muddy lake of base and contemptible pleasures. For, who shall thoroughly consider and weigh what we have hitherto said, will plainly see a continual and orderly progress, from the simplest, highest, and most common conception that we frame of a Body in general, to the furthest and most abstruse effects, that in particular are to be found in any Body whatever: I mean, any that is meerly corporeal, without mixture of a nobler nature; for, hitherto we have not moved, nor so much as look'd out of that Orb. He shall find one continued thread, spun out from the beginning to the end: He will see, that the various twisting of the two *species* of Bodies, Rare and Dense, make the yarn, of which all things and actions within the sphere of matter are woven.

And though peradventure, in the drawing out of the thread, there may be some little bracks; or the stuff made of it be not every where so close wrought, as a better workman at more leisure might have done: yet truly, I believe, that the very consent of things throughout is such, as demonstrates, that the main contexture of the doctrine I have here touch'd is beyond quarreling at. It may well be that, in sundry particulars, I have not lighted on exact truth: and I am so far from maintaining peremptorily any thing I have here said, as I shall most readily hearken to whatever shall be objected against it; and be as ready, upon cause, to desert my own opinions, and yield to better Reason. But withal, I conceive,



ceive, that, as the failing of a brick here and there in the rearing of the walls of a house doth nothing at all prejudice the strength and security of the fabrick; no more (I hope) will the slight escapes, which so difficult a task, as this is subject to, endamage, or weaken the main body of what I have here deliver'd. I have not yet seen any piece upon this subject made up with this method; beginning from the simplest and plainest notions, and composing them orderly, till all the principal variety, which their nature is capable of, be gone through: and therefore it cannot be expected, but the first model of this kind (and moulded by one distracted with continual thoughts of a much different strain; and whose exercise, as well as profession, hath allow'd him but little commerce with books and study) must needs be very rough hew'd, and require a great deal of polishing. Which whoever shall do, and be as exact and orderly in treating of Philosophy and Theology, as Mathematicians are in delivering their Sciences; I assure my self, that Demonstrations might be made, and would proceed in them as currently, and the conclusions be as certain and full, as in the Mathematicks themselves. But, that is not all; *these Demonstrations* would have the odds exceedingly of the other, and be to us inestimably more advantagious: for, out of them, spring much higher and nobler effects for mans use and life, than out of any Mathematical ones. Especially when they extend themselves to the government of Man, as Man; which is an art, as far beyond all the rules of Physick, or other government of our Body, or Temporal goods, as the End is beyond the Means we employ to gain it: for, all the others but serve instrumentally to this end, That we may live well; whereas these immediately teach it.

These are the fruits, in general, that I hope may in some measure grow out of this discourse, in the hands of equal and judicious Readers: but, the particular aim of it is, to shew what actions can proceed from a Body, and what cannot. In the conduct wherof, one of our chief endeavours has been to shew, that those actions, which seem to draw strongly in-  
to



to the order of bodies the unknown nature of certain Entities, named Qualities, either do or may proceed from the same causes which produce those known effects, that all sides agree, do not stand in need of any such mystical Philosophy. And, this being the main hinge, upon which hangs and moves the full and clear resolving of our main and great question, Of the immortality of the Soul: I assure my self, the pains I have taken in this particular will not be deem'd superfluous or tedious: and withall, I hope, I have employ'd them with so good success, as henceforward we shall not be any more troubled with objections drawn from their hidden and incomprehensible nature, and that we stand upon even ground with those of the contrary opinion; for, since we have shew'd, how all actions may be perform'd among Bodies, without having any recourse to such Entities and Qualities as they pretend and paint out to us, 'tis now their parts (if they will have them admitted) to prove that in nature there are such.

Having then brought the Philosophy of Bodies to these terms; that which remains for us to perform is, to shew that those actions of our *Souls*, for which we call her a *Spirit*, are of such a nature as cannot be reduced to those principles, by which all corporeal actions are effected. For the proof of our original intent, no more than this can be exacted at our hands; so that, if our positive proofs shall carry us yet beyond this, it cannot be deny'd, but that we give over-measure, and illustrate with a greater light what is already sufficiently discerned. In our proceeding, we have nature preceding as, for laying for our ground the natural conceptions which mankind makes of *Quantity*, we find that a *Body* is a meer passive thing, consisting of divers parts, which by motion may be diversly ordered; and consequently, that it is capable of no other change or operation, than such as Motion may produce, by various ordering the divers parts of it: And then, seeing that Rare and Dense is the primary and adequate division of Bodies; it follows evidently, that what cannot be effected by the various disposition of rare and dense parts, cannot proceed or be effected by a pure body.



## CONCLUSION.

upon his Logical and Metaphysical works, judg whether in bulk our Doctrine be not conformable to the course of his, and of all the best Philosophers that have been, and are; though in retail or particulars, we sometimes mingle there-with our own private judgments: as every one of them hath likewise shewed us the way to do, by the liberty themselves have taken to dissent in some points from their predecessors.

And, were it our turn to declare and teach Logick and Metaphysics, we should be forced to go the way of matter and forms and privations; as *Aristotle* hath trodden it out to us, in his works of that strain. But, this is not our task for the present; for, no man, that contemplates nature as he ought, can choose but see, that these notions are no more necessary, when we consider the framing of the Elements, than when we examine the making of compounded bodies: and therefore, these are to be set apart, as higher principles, and of another strain, than need be made use of for the actual composition of compounded things, and for the resolution of them into their material ingredients, or to cause their particular Motions; which are the Subjects we now discourse of.

Upon this occasion, I think it not amiss to touch, how the latter Sectatours, or rather pretenders, of *Aristotle*, (for truly they have not his way) have introduced a model of doctrine (or rather of ignorance) out of his words, which he never so much as dream'd of; howbeit they alledge Texts out of him to confirm what they say (as Hereticks do out of Scripture, to prove their Assertions). For, whereas he call'd certain Collections or Positions of things by certain common names (as the Art of Logick requires), terming some of them Qualities, others Actions, others Places, or Habits, or Relatives, or the like: these his later followers have concieted, that these names did not design a concurrence of sundry things, or a diverse disposition of the parts of any thing, out of which some effect resulted; which the understanding, considering all together, hath expressed the notion of it by one name



name : but have imagin'd, that every one of these names had, correspondent to it, some real positive Entity or thing, separated (in its own nature) from the main thing or substance in which it was, and indifferent to any other substance; but, in all to which it is linked, working still that effect, which is to be expected from the nature of such a quality, or action, &c. And thus, to the very *negatives* of things, (as to the names of *points, lines, instants*, and the like,) they have imagined positive Entities to correspond: likewise, to the names of actions, places, and the like, they have framed other Entities; as also to the names of colours, sounds, tastes, smells, touches, and the rest of the *sensible qualitie*, and generally to all qualities whatever. Whereas, nothing is more evident, than that *Aristotle* meant by *qualities* no other thing, but that disposition of parts, which is proper to one body and not found in all; as you will plainly see, if you but examine what beauty, health, agility, science, and such other qualities, are (for by that name he calls them, and by such examples gives us to understand what he means by the word *Quality*): the first of which is nothing else but a composition of several parts and colours, in due proportion to one another: the next, but a due temper of the humours, and the being of every part of the body in the state it should be: the third, but a due proportion of the spirits and strength of the sinews: and the last, but order'd Phantasmes.

Now, when these perverters of *Aristotle* have framed such Entities under that conception which nature hath attributed to substances; they, immediately upon the nick, with the same breath that describ'd them as substances deny them to be substances: and thus they confound the first apprehensions of nature, by seeking learned and strained definitions for plain things. After which; they are fain to look for gliew and paste, to join these Entities to the substance they accompany: which they find with the same facility, by imagining a new Entity, whose nature it is to do that which they have need of.

And



And this is the general course of their Philosophy; whose great subtilty and queint speculations, in enquiring how things come to pass, afford no better satisfaction, than to say upon every occasion, that there is an Entity which makes it be so. As, if you ask them, how a wall is white, or black; They will tell you, there is an Entity or Quality, whose essence is to be Whiteness or blackness, diffused through the wall? If you continue to ask, how doth *whiteness* stick to the wall. They reply, that it is by means of an Entity called Union, whose nature it is actually to joyn whiteness and the wall together. And then, if you enquire, how it comes to pass, that one white is *like* another? They will as readily answer, that this is wrought by another Entity, whose nature is to be likeness, and it makes one thing like another. The consideration of which doctrine makes me remember a ridiculous Tale of a trewant School-boys Latine; who, upon a time when he came home to see his friends, being asked by his Father, what was Latine for bread? answer'd *bredibus*, and for beer? *beeribus*, and the like of all other things he ask'd him, adding only a termination in *bus*, to the plain English word of every one of them: which his Father perceiving, and (though ignorant of Latine, yet) presently apprehending that the mysteries his son had learn'd deserv'd not the expence of keeping him at School, bade him immediately put off his *hosibus* and *shoosibus*, and fall to his old Trade of treading *Morteribus*. In like manner, these great Clerks do as readily find a pretty Quality or mood, wherby to render the nature or causes of any effect in their easy Philosophy; as this Boy did a *Bus* to stamp upon an English word, and coyn it into his mock Latine.

But, to be serious, as the weight of the matter requires, let these so peremptory pretenders of *Aristotle* shew me but one Text in him, where he admits any middle distinction (such as those modern Philosophers do and must needs admit, who maintain the qualities we have rejected) betwixt that which he calls Numerical, and that which he calls of *Reason*, Notion, or Definition, (the first of which we may term to be of or in things, the other to be in our heads or discourses; or, the one



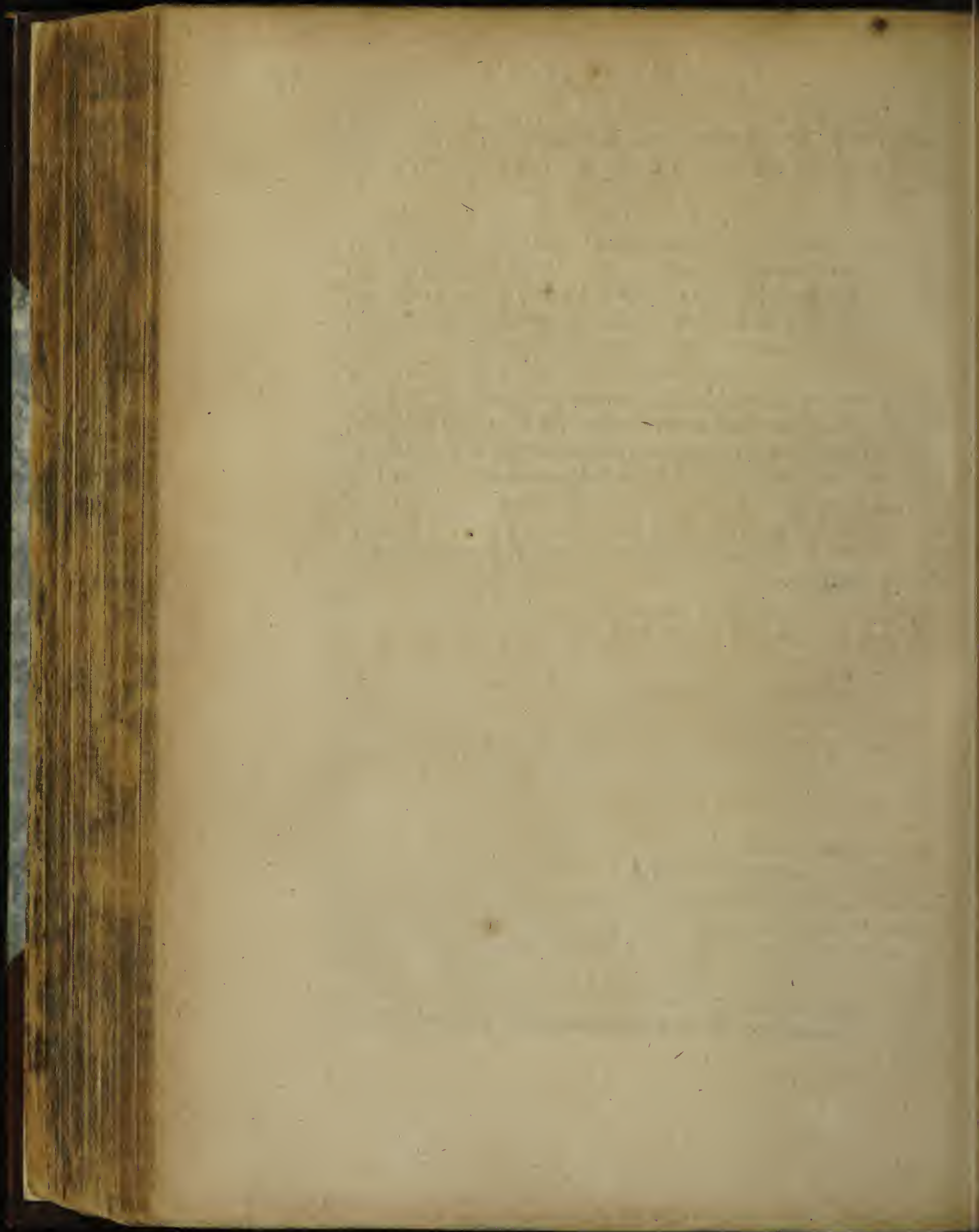
## CONCLUSION!

439

One *Natural*, the other Logical): and I will yield that they have reason; and I have grossly mistaken what he has written, and do not reach the depth of his sense. But this they will never be able to do.

Besides, the whole scope of his Doctrine, and all his discourses and intentions, are carry'd throughout, and built on the same foundations, that we have laid for ours. Which being so, nobody can quarrel with us for *Aristotle's* sake: who, as he was the greatest Logician and Metaphysician and universal Scholar, peradventure that ever lived; (and so highly esteem'd, that the good turn, which *Sylla* did the world in saving his works, was thought to recompence his many outrageous cruelties and tyranny), so, his name must never be mention'd among Scholars, but with reverence, for his unparalleld worth, and with gratitude, for the large stock of knowledge he hath enriched us with. Yet withal we are to consider, that, since his reign was but at the beginning of Sciences, he could not choose but have some defects and shortnesses, among his many great and admirable perfections.







SECOND  
**TREATISE:**  
DECLARING  
THE NATURE  
AND  
OPERATIONS  
OF  
MANS SOUL:  
OUT OF WHICH  
THE IMMORTALITY  
OF  
REASONABLE SOULS  
IS CONVINCED.

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LONDON,  
Printed in the Year, 1669.



1840

WILLIAM L. HARRIS

1840

THE NATURAL

OF

2010 T. A. HARRIS

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# PREFACE.

**T**Is now high time for us to cast an Eye on the other Leaf of our Accounts ; or peradventure, I may more properly say, to fall to the perusal of our own accounts : for hitherto, our time and pains have been taken up, in examining and casting the accounts of others ; to the end, that, from the Foot and Total of them, we may drive on our own the more smoothly. In ours then, we shall meet with a new Capital ; we shall discover a new World, of a quite different strain and nature from that, which all this while we have imploy'd our selves about. We will enter into them, with taking a survey of the great Master of all that large Family, we have so summarily view'd ; I mean of Man, as Man : that is, not as he is subject to those Laws wherby other bodies are govern'd, (for therein he hath no preeminence, to raise him out of their throng : but as he exceeds the rest of Crea-  
A a a 3. ture



## Preface.

tures subject to his managing, and rules over nature herself (making her serve his designs, and subjecting her noblest powers to his Laws) and is distinguish'd from all other creatures whatever. To the end we may discover, whether that principle in him, from whence these actions proceed which are properly his, be but some refined composition, of the same kind we have already treated of: or whether it derives its Source and Origine from some higher Spring and Stock, and be of a quite different nature.

Having then, by our former Treatise, master'd the oppositions, which else would have taken arms against us, when we should have been in the midst of our edifice; and clear'd the objections which lay in our way, from the perverse Qualities of the Souls Neighbours, the several Commonwealths of Bodies: we must now begin with David, to gather together our Materials, and take a survey of our own provisions: that so we may proceed, with Solomon, to the sacred building of Gods Temple. But, before we go about it, it will not be amiss, that we shew the reason why we have made our Porch so great; and added so long an entry, that the house is not likely to have therto a correspondent bulk: and when the necessity of doing so, shall appear, I hope my pains will meet with a favourable censure, and receive a fair admittance.

We propos'd to our selves to shew, That our Souls are immortal: wherupon, casting about to find the grounds of Immortality, and discerning it to be a negative, we conceiv'd that we ought to begin our search, with enquiring what Mortality is, and what be the causes of it. Which when we should have discover'd, and brought the Soul to their test; if we found they trench'd not upon her, nor any way concern'd her condition; we might safely conclude, that  
of



## Preface.

of necessity she must be immortal. Looking then into the causes of mortality, we saw that all Bodies round about us were Mortal; whence, perceiv'ing that Mortality extended it self as far corporeity, we found our selves obliged, if we would free the Soul from that Law, to shew that she is not corporeal. This could not be done, without enquiring what corporeity was. Now, it being a rule among Logicians that a definition cannot be good, unless it comprehend and reach to every particular of that which is defined; we perceiv'd it impossible to know compleatly what a Body is, without taking a general view of all those things which we comprise under the name and meaning of Bodies. This is the cause we spent so much time in the First Treatise; and I hope to good purpose: for, there we found, that the nature of a Body consisted in being made of parts; that all the Differences of Bodies are reduced to having more or less parts, in comparison to their substance, thus and thus order'd: and lastly, that all their operations are nothing else but Local Motions, which follows naturally out of having parts. So, as it appears evidently from hence, that, if any thing have a being, and yet have no parts, it is not a body, but a substance of another quality and condition: and consequently, if we can find the Soul's being to be without parts, and that her operations are no local translation; we evidently conclude her to be an immaterial or spiritual substance.

Peradventure it may be objected, that all this might have been done a much more shorter way than we have taken; and that we needed not have branc'd our discourse into so many particulars, nor driven them so home as we have done: but might have taken out our first rise from this ground, which is as evident, as light of reason can make it) that, seeing we know bigness and a body to be one and the same, as well in the notion as in the thing: it must of necessity fol-



## Preface.

low, that what hath not parts, nor works, nor is wrought upon by Division, is not a Body. I confess, this Objection appears very reasonable; and the consideration of it weigh'd so much with me, as, were all men of a free judgment and not imbued with artificial errours, I would, for its sake have saved myself a great deal of pains: but I find (as in the former Treatise I have frequently complain'd) that there is crept into the world a *Fansy* so contrary to this pregnant truth, and that it is so deeply settled in many mens minds (not of the meanest note) as all we have said is peradventure too little to root it out.

If any (satisfied with the rational *Maxime* we even now mentioned, therefore not deeming it needful to employ his time in reading the former Treatise) should wish to know, how this is come to pass: I shall here represent to to him the Summe of what I have, more at large, scatter'd in several places of the former Treatise. And shall intreat him to consider, how Nature teaches us to call the *Proprieties* of things, wherby one is distinguished from another, the *Qualities* of those things: and that, according to their varieties, they have divers names suited out to divers of them: some being called *Habits*, others *Powers*, and others by other names. Now, what Aristotle and the Learned *Grecians* meant by these things is clear, by the examples they give of them: they term *Beauty* and *Health*, *Habits*: the *Dispositions* of our Bodies to our Bodily *Motions*, *Powers*: as *Strength* (which is the good temper of the *Sinews*) a *Power*, and *Agility* a *Power*; so they use the names of the *Concoctive*, the *Nutritive*, the *Reentitive*, the *Excretive*, *Power*: the health of the *Eyes*, the *Ears*, the *Nostrils*, &c. they call the *Powers* of *Seeing*, of *Hearing*, of *Smelling*, &c. and the like of many others. But, later *Philosophers*, being very disputative, and desiring to seem ignorant of no-  
thing,



## Preface.

thing, (or rather, to seem to know more, than any that are gone before them, and to refine their conceptions) have taken the Notions (which by our first Masters were set for common and confused explications of the Natures, to serve for conveniency and succinctness of Discourse) to be, truly and really, particular Entities, or things of themselves: and so have filled their Books, and the Schools with unexplicable opinions, out of which no account of Nature can be given; and which is worse, the way of searching on is bar'd to others, and a mischievous Error grown into mens beliefs that nothing can be known. By this means they have choak'd the most plain and evident definition of a Body: bringing so many instances against it, that unwary men are forced to desert and deny the very first Notions of Nature and reason, For, in truth, they turn all Bodies into Spirits, making (for example) Heat, or Cold, to be of it self indivisible, a thing by it self, whose nature is not conceivable; not the disposition or proportion of the parts of that body which is said to be hot or cold, but a real thing, that hath a proper Being and Nature peculiar to it self: wherof they can render you no account; and so it may as well be against the notion of a body, as not. For, if Light, the vertue of the Loadstone, the power of Seeing, Feeling, &c. be things that work without time, in an instant; if they be not the dispositions of parts, as parts, (whose nature is to be more or less, to be next or far off, &c.) how can it be truly said, that the notion of a Body is to be of Parts? For, if this be a true definition of a Body, it follows that all corporeal qualities and actions must likewise be some disposition and order of parts, as parts: and that what is not so, is no body, nor bodilily quality or propriety.

This, then, was it that obliged me to go so far about, and to shew in common how all those effects, which are so much admired



## Preface.

admired in bodies, are or may be made and continued by the sole Order of Quantitative Parts and Local Motion: this hath forced us to anatomize Nature, and to begin our dissection with what first occurs to our sense from a body. In doing which, out of the first and most simple notion of Bigness or Quantity, we found out the prime division of Bodies, into Rare and Dense: then, finding them to be the Qualities of Dividing and of being Divided (that is, of local motion), we gain'd knowledge of the common properties of Gravity and Levity, from the combination of these we retriv'd the four first Qualities, and by them, the Elements. When we had agreed how the Elements were made, we examin'd how their action and composition raises those Second Qualities, which are seen in all Mixt bodies and make their divisions. Thence proceeding into the operations of life, we resolv'd they are composed and order'd meerly by the varieties of the former: nay, that Sense and Fantasy (the highest things we can discern out of man) have no other source, but are subject to the Laws of Parts, and of Rarity and Density. So that in the end, we became assur'd of this important Maxime, that nothing whatever we know to be a Body can be exempted from the declared Laws and orderly motions of bodies. To which, let us add two other positions, which fell also within our discovery; the First, that it is constantly founded in nature, that none of the bodies we know move themselves, but their motion must be founded in some thing without them; the Second, that no body moves another, unless it self be also moved: and it will follow evidently out of them, (if they be of necessity and not prevaricable), that some other principle beyond bodies, is required, to be the root and first ground of motion in them; as Mr. White hath most acutely and solidly demonstrated, in that excellent Work I have so often cited in my former Treatise.

But,



## Preface.

But 'tis time we should fall to our intended discourse; leaving this Point settled, by what we have already said, that, if we shew our Soul and her operations to be not-composed of parts, we also therein conclude, that she is a Spiritual Substance, and not-a-body. Which is our design and intention in this Treatise.

And, for this intent, we must look upon those actions of Man, which are peculiarly his; and upon those things which result out of them, and are call'd Opera or labores Hominum: as Houses, Towns, Tillage, Handicrafts, Arms, Ships, Common-wealths, Armies, Books, and the like; in which Great Mens lives and thoughts have been spent. In all these we find one general thrid to run quite through them, and that all of them are composed of the same stuff, and built upon the same foundation; which is a long Chain of Discourses, where every little part or Link is that which Scholars call a Syllogism: and Syllogisms we know are framed of Enuntiations, and they of single or uncomposed Apprehensions; all which are actions wrought by the Understanding of a man. But beyond these, we cannot proceed to any further sub-division of parts, and continue our selves within the Orb of Humane Actions; for simple apprehensions cannot be further resolv'd into other parts, beyond the degree of apprehensions, and yet still remain actions to a peculiar man. So that, we may be sure, we shall have left nothing out to enquiry concerning Mans actions, as he is man, if we begin with anatomizing his first bare apprehensions; and so go on by degrees, compounding them, till we come to faddom those great and admirable machines of Books and Works, which he (as I may say) weaves out of his own bowels; and the like of which is done by no other creature whatever, upon the face of our contemptible Earth.

These



## Preface.

These then ( which are all comprised under the names of Apprehensions, of Enunciations or Judgments, and of Discourses ) shall be the Subject of this second Treatise : and in it, we will first consider these operations in themselves ; which done, we will endeavour to prove, out of the nature and manner of performing them, that the Souls to whom they belong are Immaterial and Immortal.

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SECOND

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## SECOND TREATISE:

DECLARING

*The nature and operations of Mans Soul.*

### CHAP. I.

*Of simple Apprehensions.*

**T**Hat we may duly understand what a right Apprehension is, let us consider the preeminence that a man, who apprehends a thing rightly, hath over him who misses of doing so. This latter can but rove wildly at the nature of the thing he apprehends: and will never be able to draw any operation into act, out of the apprehension he hath framed of it. As for example, if a man be to work upon Gold, and, by reason of its resemblance to brass, hath form'd an apprehension of Brass, instead of an apprehension of Gold; and then (knowing that the action of fire will resolve Brass into its least parts, and sever its moist from its dry ones) will go about to calcine Gold in the same manner as he would do Brass: he will soon find that he loses his labour; and that ordinary fire is not an adequate Agent, to destroy the homogeneal nature and sever the minute parts of that fixed mettall: All which happens, out of the wrong apprehension he hath made of Gold. Whereas on the other side, he that apprehends a thing rightly, if he pleases to discourse of what he apprehends, finds in his apprehension all the parts and qualities which are in the thing he discourses of. For example, if he apprehends rightly a Knife, or a Beetle, or a Sieve, or any other thing whatever: in the Knife he will find Haft and Blade; the Blade of iron, thick on the back and thin on the edg, temper'd to be hard and tough, thus beaten, so ground, in such manner softned, thus quenched, and whatever else concerns

<sup>I.</sup>  
What is a right apprehension of a thing.



cerns the Being or making of a *Knife*. And all this he draws out of his notion or apprehension of a *Knife*; which is, that 'tis An instrument fitted to cut such and such things, in such a manner : for, hence he finds, that it has a *Haft*, fit to hold it by in ones hand, to the end it may not hurt the hand, whiles it presses upon the *Knife*; and that the *Blade* is apt to slide in betwixt the parts of the thing which is to be cut, by the motion of being pressed or drawn by the hand : and so he proceeds on, descending to the qualities of both parts; and how they are to be joyn'd, and held fast together. In the like manner, he discourses of a *Beetle*, a *Sieve*, or whatever else comes in his way. And he doth this, not only in such manufactures as are of mans invention; but (if he be capable) he doth the like in *Beasts*, in *Birds*, in *Trees*, in *Herbs*, in *Fishes*, in *Fossiles*, and in what creature soever he meets within the whole extent of nature. He findes what they are made for; and, having discover'd Natures aim in their production, he can instruct others what parts and manner of generation they have, or ought to have : and, if he, that in this manner apprehends any thing rightly, hath a mind to work upon it, either to make, or use and order it to some end of his own : he is able, by his right apprehension, to compare it to other things, to prepare what is any way fitting for the making of it, to apply it to what it will work its effect upon, and to conserve it from what may wrong or destroy it. So, if he have framed a right apprehension of a *Sieve*, he will not employ it in drawing water; if of a *Beetle*, he will not go about to cut with it : neither will he offer, if he have a due apprehension of a *Knife*, to cut stone or steel with it, but wood, or what is softer. He knows what will whet and maintain the edge of it; and understands what will blunt or break it : In fine, he uses it in such sort, as the *Knife* it self (had it knowledg and will) would wish to be used; and moves it in such a manner, as, if it had power of motion, it would move it self. He goes about the making of it, even as Nature would do, were it one of her *Plants* : and in a word, the *Knife*, in this apprehension made in the man, hath those causes, proprieties, and effects, which are natural to it, and which nature would give it, if it were made by her; and which are proportionable to those parts, causes, proprieties, and effects, that Nature bestows on her children and creatures, according to their several essences.

What



What then can we imagine, but that the very nature of a thing apprehended is truly in the man who apprehends it? And that, to apprehend ought is to have the nature of that thing within ones self? And that man, by apprehending, becomes the thing apprehended; not by change of his nature to it, but by assumption of it to his?

2.  
The very thing it self is truly in his understanding who rightly apprehends it.

Here peradventure some will reply, that we press our inference too far; and will peremptorily deny the things real Being in our mind, when we make a true and full apprehension of it: accounting it sufficient for our purpose, that some likeness or image of the thing be there; out of which we may draw all these, whether contemplations or works, or disposals of the thing. But, by that time this objection is thoroughly look'd into, and so much as they allow duly examin'd, I believe we shall find our quarrel to be only about the word, not the matter; and that indeed both of us mean the same though diversly conceiv'd, their expression, in what they grant, importing in substance the same as ours: which, 'tis true, they first deny in words; but that may be, because the thing is not by them rightly understood.

Let us then discuss the matter particularly. What is likeness, but an imperfect unity between a thing and that which 'tis said to be like to? If the likeness be imperfect, 'tis more unlike than like to it: and the liker it is, the more 'tis one with it; till at length, the growing likeness may arrive to such a perfection, and to such an unity with the thing 'tis like to, that then it shall no longer be like, but is become wholly the same with that formerly it had but a resemblance of. For example, let us consider, in what consists the likeness to a Man, of a Picture, drawn in Black and White representing a Man: and we shall find, 'tis only in the proportion of the limbs and features; for the colours, the bulk, and all things else are unlike. But, the proportions are the very same, in a Man & in a Picture; yet that Picture is but a likeness, because it wants bigness and colour: give it them, and nevertheless it will be but a likeness; because it wants all the dimensions of corporeity or bulk, which are in a mans body. Add also those to it, and still it will be but a likeness or representation of a man, because it wants the warmth, the softness, and the other qualities of



of, a living body, which belongs to a man: but if you give it all these, then it is no longer a likeness or image of a living creature, but a living creature indeed. And if peradventure this living creature continue still to be but the likeness of a man, 'tis because it wants some perfections or proprieties belonging to a man; and so in that regard 'tis unlike a man: but, if you allow it all those: so that in nothing it be unlike, then your taking away all unlikeness takes away likeness too; and as before, of dead, it became a living creature so now, of another living creature, it becomes a mans and is no longer, like a man. You see then plainly the reason, why that, which we call a like thing is not the same; for in some part it is unlike: but if the likeness were complete in every regard, then it were no longer to be called like, but the very thing it self. And therefore we may conclude, that, if the likeness of a thing, which the objection allows to be in our knowledge, contains all that is in the thing known; then it is in truth, no more a likeness, but the very known thing it self: and so what they grant amounts to, as much as we require; though at first they go about to exclude it.

3.  
The apprehension of things, coming to us, by our senses, are resolvable into other more simple apprehensions.

Having thus concluded, that, when we apprehend any thing, that very thing is in Us, let us in the next place examine how it comes thither, and what it is there. Which we shall best do, by anatomising and looking narrowly into the nature of such apprehensions, as we daily make of things: 'Tis true, we said even now, that we cannot divide the actions of mans mind, further than into Apprehensions; and therefore we call'd them simple and uncomposed: and with good reason, for, if we reflect upon the operations of our mind, we shall evidently perceive, that our bare apprehensions, and only they, are such. But withal, we must acknowledg, that all the apprehensions we make, of things coming unto us, by our Senses, are composed of other more single apprehensions, and may be resolv'd into them: all which are as it were the limbs and parts, that make up and constitute the other total one.

4.  
The apprehension of a being is the most simple, and basis of all the rest.

Let us make use of our former example, & dissect the apprehension we make of a Knife. I find in my understanding, that it is a thing so long, so broad, so sharp, so heavy, of such a colour, so moulded, so temper'd, &c. as is fit to cut withall. In this total apprehension



apprehension, I discover three kinds of particular apprehensions; every one more simple and refined than the other. The highest of them, and the foundation upon which the others are built, is the notion of Being; which is of so high and abstracted a nature, that we cannot retrieve words to express in what manner we conceive it: but are fain to content our selves with the outward sound of a word, by which, without describing our own, we stir up the like conception in another; and that is the word, Is, by which we intimate the Being of the thing we apprehend: And this notion can be in our mind, without inferring any other: and therefore is the simplest of all others; which, of necessity, must imply it, and cannot be without it, though it can be without them.

Our next apprehension is of that which hath Being; and is expressed by the word Thing. This is not so simple as the former; for it is composed of it, and of what receives it (of Being and what hath Being): yet it is much simpler than the next degree of apprehensions, which is caused in our mind by the great variety of things, that come thither through our senses; and can be conceiv'd without any of them, though none of them can without it. For, I can have in me the notion of a thing, abstracting from all accidents whatever (as, magnitude, figure, colour, resemblance, or the like); but, I cannot conceive it to be long, or sharp, or blew, &c. without allowing it first to be somewhat or something, so affected: so that the apprehension of a thing, or of that which hath Being, is the *Basis* of all our other subsequent apprehensions; as the apprehension of Being is the *Basis* of the apprehension of a thing. For, had it not Being, it were not a thing, and were it not a thing, it could not be said to be a long thing or a sharp thing, nor indeed, that it were long or sharp; for to be so includes Being, and what hath Being is a Thing. And thus we may observe, how the bulk of our apprehensions is composed of something adventitious, and of something formerly within us: which is of a very different nature from all the others; and yet so fitted and necessary to them, that none of them can be without it, though it not only can be, but is best conceiv'd without relation to any of them.

We shall easily discern, of how different a strain this conception of Being is from all others, that enter by our Senses, (as from

B b b

5.  
The apprehension of a thing is in next degree to that of Being; and it is the Basis of all the subsequent ones.

6.  
The apprehension of things known to us, by our senses, consists in certain respects betwixt the two things.



the conceptions of colours, of sounds, and the like); if we but reflect upon that act in us which makes it, and then compare it with the others. For, we shall find, that all they consist in or of certain respects betwixt two things; whereas this of Being is an absolute and simple conception of it self, without any relation to ought else: and cannot be described or expressed with other words, or by comparing it to any other thing; only we are sure, we understand and know what it is.

But, to make this point the clearer, it will not be amiss, to shew more particularly, wherein the other sorts of apprehensions are different from this of Being: and how they consist in certain respects between different things, and are known only by those respects; whereas this is known only in it self, abstracting from all other things whatever. An example will do it best. When I apprehend the whiteness in the Wall, I may consider how that white is a thing which makes such an impression upon my fantasy; and so accordingly, I know or express the nature of white, by a respect or proportion of the wall to work upon my fantasy. In like manner, if we take a notion that arises out of what enters immediately by our senses, (for, by joyning such also to the notion of Being, we make ordinary apprehensions); we shall find the same nature: as, when I consider how this white wall is like to another white wall; the apprehension of likeness that I have in my mind is nothing else but a notion, arising out of the impression which both those walls together make upon my fantasy. So that, this apprehension is, as the former, a certain kind of respect or proportion of the two walls to my imagination: not as they make their impressions immediately upon it; but, as another notion arises, out of comparing the several impressions which those two white walls made in it.

7.  
Respect or relation hath not really any formal being, but only in the apprehension of man.

Let us proceed a little further, and examine what kind of thing that is, which we call respect or proportion; and where it resides. We shall find, that there is a very great difference, between what it is in it self, or in its own essence; and what it is in the things that are respective. For, in them, it is nothing else but the things being plainly and bluntly what they are really in themselves: as for example, two white walls to be *like* is, in them, nothing else, but each of them to be white; and two quantities to be *half* and *whole* is, in them, nothing else, but each quantity to be just what it is.

But



But a respect, in its own nature, is a kind of tye, comparison, tending, or order, of one of those things to another; and is nowhere to be found in its formal subsistence, but in the apprehension of man: & therefore it cannot be described by any similitude, nor be expressed by any means, but (like *Being*) by the sound of a word, which we are agreed on to stir up in such a notion. For in the things, it is not such as our notion of it is, (which notion is that we use to express by *Prepositions and Conjunctions*, and which *Aristotle* & *Logicians* express in common, by the word *προς* or *ad*) & therefore there is nothing out of us to paint it by (as I could do white or square, or round, or the like, because these have a being in the things that are white, or square, &c. & consequently they may be expressed by others of the like nature): but the likeness that one white hath to another, or the respect that either of them hath to mans imagination, is only in man; who, by *comparing* them, gives birth to the nature and being of respect.

Out of this discourse, we may collect two Singularities of Man; which 'twill much import us to take particular notice of. One is, that Being or a thing (the formal notion of which is merely Being) is the proper affection of man. For, every particular thing is in him, by being (as I may say) grafted upon the stock of Existence or being. And accordingly we see, that whatever we speak of we say) is *something*, and whatever we conceive we give the nature of a thing (as when we have said, the wall is white, we frame whiteness as a thing; so immediately before speaking of Respect, we took respect as it were a thing, and enquired, where it is): so that 'tis evident, all the negotiation of our understanding trades in all that is apprehended by it, as if they were things.

The other Singularity we may observe in man is that he is a comparing power: for all his particular knowledges are nothing else but respects and comparisons between particular things; as for example, for a man to know heat, or cold, &c. is to know what effects fire or water, &c. can work upon such or such bodies.

Out of the first of these proprieties it follows, that what effects a man, or makes impression upon his understanding, doth not thereby lose its own peculiar nature, nor is modified to the recipient: the contrary of which, we see happens perpetually

8.

That Existence or being is the proper affection of man: and that mans Soul is a comparing power.

9.

A thing by coming into the understanding of man, looseth nothing of its own peculiar nature.



petually in bodies. Observe the sustenance we take; which, that it may become part of our body, is first changed into a substance like our body, and ceases being, what it was. When water or any liquid body is receiv'd into a vessel; it loses its own figure, & puts on the figure of the vessel it is in. If heat enters into a body, that is already hot, that heat becomes thereby more heat; if into a cold body, it is converted into warmth. And, in like manner, all other corporeal things are accommodated to the qualities of the recipient; and in it they lose their own proper terms and consistences: but what comes into the understanding of a man is so received by, or joyn'd to him, that it still retains its own proper limitations and particular nature notwithstanding its assumption to him. For, Being is joyn'd to every thing there; since as we have said ) 'tis by Being, that any thing comes thither: & consequently, this stock of Being makes every graft, that is inoculated into it, Be what of its own nature it is. For, Being joyn'd to another motion, doth not change that notion, but makes it be, what it was before; since, if it should be changed, Being were not added to it: as for example, add Being to the notion of knife, and it makes a knife, or that notion to Be a knife; and if, after the addition, it doth not remain a knife, it was not Being that was added to a knife!

So.  
A multitude of things may be united in mans understanding, without being mingled or confounded together.

Out of the later of the singularities proper to man, it follows, that a multitude of things may be united in him, without suffering any confusion among themselves; but every one of them will remain with its proprieties, and distinct limitations. For so of necessity, it must be, when that which unites them to him is the comparing them to something besides themselves: which work could not be perform'd, unless what is to be compared retain exactly its own nature, whereby the comparison may be made no more, than one can weigh two quantities one against another, unless he keep asunder what is in each seal, and keep all other weights from mingling with them. And accordingly we see, that we cannot compare black to white, or a Horse to an Oxe; unless we take together the properties, by which black differs from white, or an oxe from an horse: and consequently they must remain unmingled and without confusion, precisely what in themselves they are, and be indifferent in the sight of the comparer.

But



But indeed, if we look well into the matter, we shall find, that, setting aside the notion of Existence or Being, all our other notions are nothing else but comparisons and respects: and that, by the mediation of respects, the natures of all things are in us; and, by the varying of them, we multiply our Notions. Which in their first division) that reduces their several kinds into general heads) increase into the Ten famous Tribes, that Logicians call Predicaments: and they comprehend under them all the particular notions that man hath, or can have; according to the course of knowledge in this life. Of which Predicaments the seven last are so manifestly respective, that all men acknowledg them to be so. Substance we have already shew'd to have a respect to Being. Quantity we proved (in the first Chapter of the former Treatise, of the Nature and Operation of Bodies) to consist in a respect to *Parts*. Quality is divided into four branches: wherof, Power is clearly a respect to that over which it hath power, or from which it may suffer: Habite is a respect to the substance wherein it is; as being the property by which it is well or ill, conveniently or inconveniently affected, in regard of its own nature (as you may observe in health, or sickness, or the like): The Passible Qualities are those we have explicated, in discoursing of the Elements and of Mixts; and whose natures, we have there shew'd, consist in respects of acting or suffering: Figure or shape (which is the last branch of the division of the Predicament of Quality) is nothing else, but a certain disposition of one part of a body to another. And so you see, how all the Ten Predicaments consist purely in diversity of Respects: & by consequence, all our conceits and notions (excepting that of Being, which is the stock upon which all the rest are grafted) are nothing else but various respects; since all of them whatever are comprised under those general heads. Concerning which, we shall not need to dilate our selves any further; seeing they are to be found in *Aristotle*, and his Commentators, largely discours'd of

In the next place, let us observe, how our understanding behaves it self, in considering and apprehending these Respects. We have already declared, that the variety of our notions arises out of the respects which divers things have to one another. Hence will follow, that, of the same thing, we may have various

II.  
Of Abstracted  
and Concrete  
terms.



notions: for, comparing it to different things, we shall meet with different respects between them; and consequently, we shall consider the same thing, under different notions. As when we consider an Apple, under the notions of greenness, of sweetness, of roundness, of mellowness, &c. as we have amply declared in the *First Treatise*; and therefore need not here enlarge our selves any further upon this particular. Now, these notions are so absolutely sever'd one from another, & every one of them hath such a compleatness within it self; that we may use any one of them, without meddling at all with any of the others. And this we do two several ways: One, when our manner of apprehension determines us to one precise notion, which is so sum'd up within it self, as it not only abstracts from all other notions, but also quite excludes and admits no society with them: The other, when we consider a thing under a determinate notion, yet in such a manner, that though we abstract from all other notions, nevertheless we do so, rather by neglecting, than by excluding them; and, even in the manner of our expression of it, we insinuate that there are other notions (without specifying what) belonging to it.

Of the first kind of notions are Whiteness, Weight, Heat, and such like; whose names are call'd abstracted terms: which, though they rise out of our comparing the things that are white, heavy, hot, &c. to our fantasy, or to other things; yet these notions are so precise and shut up within themselves, that they absolutely exclude all others, (as of long, short, square, rough, sharp, or whatever else) which may in the things accompany the whiteness, weight, heat, &c. that our consideration is then busied only with. Of the second kind of notions are white, heavy, hot, &c. whose names, expressing them, are call'd Concrete Terms: which, though they cause in us no other apprehensions, than of whiteness, weight, heat, &c. yet they are not so rigorously paled in, as the others are, from admitting society with any besides; but imply tacitely, that the thing which is white, heavy, hot, &c. hath, besides that, some other consideration belonging to it (whatever it be) which is not expressed.

Now, in this later abstraction, it happens sometimes, that the



the notion expressed hath but an accidental connexion with the other notions, that are in the thing unexpressed : as for example, 'tis meerly accidental to the white wall, as it is white, to be high, or low, of stone, of plaister, or the like. But, otherwhiles, the expressed notion is so essential to the concealed ones, that they cannot be without it : as, when we apprehend a cloven foot, though this apprehension abstracts from all other notions besides cloven-footedness (if so I may say); yet, (as above we have declar'd) 'tis in such a manner, that it implyes other considerations, not yet expressed, in that cloven foot. Among which, some may be of that nature, that they cannot have a being without pre-supposing cloven-footedness; but others may be meerly accidental to that notion. As (for instance sake) let one be, that the foot is cloven into three parts; and let another be, that it is black or hairy : of these, this later notion, of black or hairy, is of the first kind of abstractions, which we said had but an accidental connexion with that which comprehended them without expressing them (for, other things besides the cloven foot may be black or hairy; as height or lowness, to be of stone or of plaister, may belong to other structures besides the white wall); but to be cloven footed into three parts so necessarily depends of being cloven footed in general, (which implyes this particular) and so directly includes it, as it cannot subsist without cloven-footedness. For, though we may conceive a foot to be cloven, without determining in our apprehension, into how many toes it is cloven; yet we cannot conceive it to have three, four, or five toes, without apprehending it to be cloven. So that, in such like apprehensions, the notion expressed is so essential to the notion that's conceal'd and added to it, as the concealed one cannot be conceiv'd without the expressed one; and whenever it is mention'd, the other is necessarily also brought in and affirm'd with it.

Now, some of these later kinds of notions, (in which what is expressed is essential to what is concealed) may be of such a nature, as to be capable of receiving the addition of sundry other notions, so repugnant to one another, that they cannot agree together in one subject; and yet that general notion, without determining any of the others, be indifferent to the contrary additions that include it, and belong as much to any one, as to any

12.  
Of Universal  
notions.



them: and so consequently, whatever may be affirm'd, & is true, of the primary notion, may as well be affirm'd, & is as true, of the several particulars, arising out of the repugnant additions. Such a notion Logicians term an Universal one: that is, one that reaches, indifferently and equally, to all the particulars comprised under it. As for example, to the notion of a *living creature* may be added the notions of Reasonable & Unreasonable: which first notion when it is barely expressed determines no one of the two secondary notions, more than the other, but is alike indifferent to either: and whatever belongs to a *Living Creature* belongs entirely both to a Man and to a Beast: yet no one thing can be both Reasonable and Unreasonable. In like manner, when I say, a man is a discursive creature, under this word man there lies a notion, by which may be signifi'd any particular man, as *Thomas, John, William, &c.* though of it self, it determine no one man whatever & consequently, every one of these particular men, must be allow'd to be a discursive creature, because the being such belongs to the notion of man, and that notion to all the particulars of *Thomas, John, William, &c.* and yet no particular man can be both *Thomas* and *John*, or *John* and *William, &c.*

In this kind of notion, we may observe yet one propriety more: which is, that of it self, and in its common term, it doth not cause ones thought to range to several objects, nor imply's that there are many particulars comprised under it; yet, if there be never so many, that conceit will fit them every one, & if there be but one, still it will be no less accommodated to that one. As for example, He that makes a right apprehension of a *Sun*, doth not by that conception determine, whether there be many *Suns* or but one: and if every one of the Stars (which we call fixed) be *Suns* to other Earths, it fits them all; and if there be no other Sun, than that which shines to us, it is satisfied and taken up with that. So likewise, before the production of *Eve*, the notion of a man was as fully taken up by *Adam* alone, as it is now by his numerous progeny that fills the world: nor doth our understanding, when that term is pronounced consider (out of the force of the term) whether there be many men, or only one.

13.  
Of apprehending a multitude under one notion.

Another propriety in mans apprehension, not much unlike



to this, is, that he is able to comprise a Multitude in one indivisible notion; and yet, that notion shall express the multiplicity of what it contains. As we see in *Numbers*, where the indivisible conception of ten, a hundred, a thousand, &c. plainly expresses the subject to be many; & yet that notion of the number binds them up (as I may say) into one bundle, that in it self admits no division, nor will permit that the least part be taken from it: for, if it be, the whole bundle is destroy'd and vanishes; as when I take ten, if one be diminish'd from it, it is no longer ten, but nine. It fares in like manner with the conceptions we frame of All and Every one, as it doth with *Numbers*: for, if but one be deficient, it is but a part, and not all, or every one. So that these notions do indivisibly terminate a Multitude. And, like to this notion is the name or term whole; in respect of things which as yet have not division, but are capable of being divided: for, it is so rigorous, that if the least atome or thought, be wanting, it is no longer the whole, but only a part.

And, this is as much as at present appears needfull to be said, concerning Single apprehensions. Unless I be permitted to add, for a conclusion, this little note, (which peradventure might have been more properly set down in another place, where we discoursed of Being; but that it occur'd not then to me); that, Apprehension being rooted in the nature of Being, the power of it spreads it self as far as the extent of Being; and consequently reaches to all things whatever; for, whatever is a thing, hath Being, and that to which Being doth not reach is *nothing*. Nay, it is not limited there, but grasps even at nothing, and aimes to make a notion of it; and plants its generation, multiplying it self by negations of whatever is. Hence we have the notions of Deafness, Dumbness, Blindness, Lameness, Baldness, Death, Sin, and of all Evils whatever; by the want of such Goods, as are sensible to us.

14.

The power of the understanding reaches as far as the extent of being.



## CHAP. II.

*Of Thinking, and Knowing.*

I.  
How a Judg-  
ment is made  
by the Under-  
standing.

**H**AVING thus declared the nature of single apprehensions, the method we have prescrib'd our selves requires, that we examine, in the next place, what effect the joyning them together may have : for, from thence spring Enunciations or Judgments, which are in the next rank after simple Apprehensions, and the materials whereof Discourses are immediately framed; as when of the two apprehensions, knife and sharp, we may make this Enunciation, the knife is sharp. In this enquiry the first thing that occurs to us is, to consider in what manner two differing simple Apprehensions become joyn'd to one another. And we shall find, that they are not tyed together, like several distinct things, in one bundle, or like stones in a heap, where all that are compris'd under one multitude are yet circumscrib'd within their own limits, and thereby wholly distinguish'd from each other : but, that they are as it were grafted upon one stock, which, being common to both, gives the same life to both ; and so, becoming one with each of them, makes them to be one and the same thing between themselves. And this is the notion of Being or Existence, in the subject we speak of : which (as we have already shew'd) is the *Basis* and Foundation of all other Apprehensions, and, by being common and indifferent to all, is the fittest glew to unite those that are capable of such conjunction. And accordingly we see, that most of our speech runs upon this strain, that this is that, or doth that (which is as much to say, as, is doing that), that *Socrates* is a man, or that *Socrates* runs, (which signifies, is running) ; and the like : and, since our speech proceeds from the conceptions of our mind, 'tis clear, that as the words which express Being or Existence joyn together the other words that we use, (or at least, the greatest part of them); so likewise in our mind, the Apprehension of Being is the glew that joyns our Apprehensions corresponding to our words.

All which will appear to be said with great reason, if we reflect on it. For, when diverse apprehensions may be thus joyn'd together, it is indeed, that one and the same thing affecting us  
several



veral ways, and under different considerations, those different expressions beget different apprehensions in us, and so, till we examine the matter, every one of them seems to be a different thing: but, when we trace these streams up to the Fountain-Head, we discern that all of them belong to one and the same thing, and that, by being in that thing, they are among themselves the very same thing, however they affect us variously; and therefore may truly be said to be one, as indeed they are. And consequently, nothing is more fit to joyn together in our mind those different apprehensions, than the apprehension of Being; which makes us apprehend as one thing those notions, which, really, and in the thing it self, are but one: as we have often touched, both in the former Treatise, and lately in this. For, this is the way to joyn things in the mind intelligently, and according to the proper nature of the mind; which receiving impressions from things existent, ought to consider those impressions as they flow from the very things, and not as they are in the mind it self; and, by mediation of those impressions, must take a survey of the things themselves; and not stay at the intellectual impressions they make in her. And consequently, must apprehend those things to be one in themselves, (though in us they be not so) according to the course of our Original and Legitimate apprehensions of things, which is, as they are *existent*; that is, as they are in their own nature, and in themselves; and not according to the discourses and secondary apprehensions we make of the images we find of them in our mind. And thus things are rightly joyn'd by apprehension: without caution in which particular, we shall run into great errors in our discourse. For, if we be not very careful herein, we are apt to mistake the use of the impressions we receive from things; and to ground our judgments concerning them, according to what we find of them in our mind, and not according to what they are in themselves: which two several considerations have quite different faces, though ('tis true) those impressions are made by the things, and are the only means by which we may rightly judg of them; provided, that we consider them, as they are in the things, and not as they are in us.

Now, this conjunction of apprehensions, by the mediation and glew of Being, is the most natural and fitting, not only in regard



regard of the things, but even of us : for (as we have already shew'd) it is of all others the most common and universal, the most simple or uncomposed, and the most natural and deepest rooted in man. Out of all which 'tis evident, that this union of apprehensions by the means of *Being* is, in truth, an Identification of them : for, Unity being a negation of multiplicity, it follows, that what is one, is the same : and this Identification is truly and naturally expressed by saying, that the one is the other.

3.  
How the notions of a Substantive and an Adjective are united in the Soul, by the common stock of Being.

But, insisting a little further upon this consideration, how different apprehensions become joyn'd and united together by the notion of Being ; we may observe that this happens, not only to two single ones, but to more : according as more than two may belong to one thing ; and it may so fall out, that more than one be on either side the common ligament. Thus, when we say, A man is a discursive creature, or a rational Soul is an immortal substance ; the two apprehensions, of discursive and creature, are joyn'd together in a third, of Man, by the tie of *one* Being : and the two apprehensions, of Immortal and Substance, are likewise united to the two others, of Rational, and of Soul, by the ligament of one single Being : Evident it is then, that the extremes are united by one Being : but, how the two apprehensions, that are rank'd together on the same side of the ligament, (as in our former examples, the apprehensions of Discursive & Creature, of Rational and Soul, of Immortal and Substance ) are between themselves joyn'd to one another, is not so easy to express. 'Tis clear, that it is not done by meer conglobation ; for, we may observe, that they belong, or are apprehended to belong, to the same thing ; ( and the very words that express them, intimate so much, by one of them being an Adjective ; which shews, they are not two things ; for, if they were, they would require two Substantives to describe them ; and consequently it follows that one of them must needs appertain to the other, and so both of them make but one thing.

And, there is no doubt, but, in the inward apprehension, there is a variety correspondent to the variety of words which express it ; since all variety of words, that is made by intention, results out of some such variety of apprehensions. Therefore, since the words import, that the things have a dependance one of the



the other; we cannot doubt, but that our apprehensions have so too. Which will be conceiv'd best, by looking into the act of our mind, when it frames such variety of apprehensions belonging to one thing, correspondent, to the variety in words of an Adjective glew'd to its Substantive; and attending heedfully to what we mean, when we speak so. The *Hebrews* express this union, or comprising of two different apprehensions under one notion, by putting in the Genitive case the word which expresses one of them; (much like the rule in *Lillie's Grammar*, that *When two Substantives come together, if they belong to the same thing, the one is put in the Genitive case*): As when in the Scripture we meet with these words, the Judge of injustice, the Spence of wickedness, the man of sin, or of death; which, in our phrase of speaking, signify an unjust Judge, a wicked Spence, and a sinful or dead man. In which 'tis evident, that as well the manner of understanding, as of speaking, takes each pair of these notions to belong to one thing; that is, to have both of them one and the same *Existence*, though there intervene not the formal expression of their being *one*. Thus we see, how one Being serves two different ways to joyn and unite several apprehensions: and, if we will examine all the negotiations of our understanding, we shall hardly find any notions so far distant, but may be brought together, either by the one of these ways, or by the other.

But, this composition and joyning of several apprehensions by the glew of Being is not sufficient, to make us deem a thing to be really such, as their union paints in the mind, or as the words so tied together express in speech. Well may it cause us to think of the thing: but to think or deem it *such* an one (which word, deeming, we shall be obliged hence forward to use frequently, because the word thinking is subject to equivocation) requires the addition of something more, than barely this composition of apprehensions; which unless they be kept straight by some level, may as well swerve from the subject, as make a true picture of it. Here then we are to examine, what it is that makes us think any thing to be such as we apprehend it. This we are sure of, that, when we do so, our actions, which proceed upon reason, and have relation to that thing, are govern'd and steer'd in every circumstance, just as if the thing were truly so.

As

4.  
That a settled  
judgment be-  
comes a part of  
our Soul.



As for example, if a man really deem the weather to be cold, or that his body is distemper'd, he puts on warmer cloaths, or takes physick, though peradventure he is mistaken in both: for, his deeming them to be so, makes him demean himself as if really they were so. 'Tis then evident, that, by such thinking or deeming, the nature conceiv'd is made an active principle in us. To which if we add, that all the knowledge we have of our Soul is no more, but that it is an active force in us; it seems, that a thing, by having apprehensions made of it in our mind and being really thought agreeable to such apprehensions, becomes, (as it were) a part or affection of our Soul, and one thing with it. And this peradventure is the cause, why an understanding man cannot easily leave an opinion once deeply rooted in him; but wrestles and strives against all arguments that would force him from it, as if part of his Soul or Understanding were to be torn from him: in such manner as a beast will cry and struggle to save his body, from having any of his limbs disjuncted or pull'd in pieces.

5.  
How the Soul  
comes to deem  
or settle a  
Judgment.

But, this observing the effect, which follows of our deeming a thing to be thus or so, is not sufficient to inform us, what it is that causes that deeming. We must therefore take the matter a little higher, and look into its immediate principles: and there we shall find, that 'tis the knowing of what we say to be true, and the assurance that the things are as we deem them, which quiets our Soul, and makes it consent to them, and proceed to action upon that consent. Now, this knowledge is the most eminent part of deeming, and, of all our acquisitions, the most inseparable from us: and indeed, in rigour, it is absolutely inseparable by direct means; however peradventure by indirect means it may be separated.

Let us then consider how we attain to it, and how sometimes we fail in the purchase of it; and what degrees of assurance or of probability there are between It and Error. To this intent, we may observe, that the greatest assurance and most eminent knowledge we can have of any thing is, of such Propositions as in the Schools, are call'd Identical: as if one should say, John is John, or a man is a man: for, the truth of these propositions is so evident and clear, as it is impossible any man should doubt of them, if he understand what he



he saies ; and, if we should meet with one that were not satisfied of the verity of them, we would not go about to prove them to him, but only apply our selves to make him reflect on the words he speaks, without using any further industry to gain his assent therto. Which is a manifest sign, that, in such Propositions, the apprehending or understanding them, is the same thing, as to know and consent unto them : or at the least, that they are so necessarily conjoyn'd, as the one follows immediately out of the other, without needing any other cause to promote this effect, more than that a man be disposed, and willing to see the truth. So as we may conclude, that, to understand a Proposition, which carries its evidence with it, is to know it. And by the same reason, though the evidence of a Proposition should not at first sight be presently obvious to us ; yet, if with unfolding and explicating it, we come at length to discern it, the apprehending of it is the knowing it.

We must therefore enquire, what it is that causes this evidence. And to that purpose, reflecting upon those instances we have given of Identical Propositions, we may in them observe, that evidence arises out of the plain Identification of the extremes that are affirm'd of one another : so that, in what Proposition soever the Identification of the extreme is plain, the truth of it is evident to us, and our mind is satisfi'd and at quiet, as being assured that it knows it to be so, as the words say it. Now, all affirmative Propositions, by their form, import an Identification of their extremes ; for they all agree in saying, This is that. Yet they are not all alike in the evidence of their Identification : for, in some it shews it self plainly, without needing any further help to discover it ; and those are, without any more ado, known of themselves, (as, such Identical sayings, we even now gave for examples) : others require a journey somewhat further about, to shew their Identification. Which if it be not so hidden, but that it may in the end be discover'd and brought to light, as soon as that is done, the knowledge settled by them in the Soul is certain and satisfactory, as well as the other : but, if it be so obscure, that we cannot display the Identification of it ; then our mind suspends his assent, and is



unquiet about it, and doubts of the truth of it: In some Propositions, whiles he searches and enquires after the Identification of their extremes, peradventure he discerns, that it is impossible there should be any between them; and then, on the other side, he is satisfi'd of the falsity of them: for, if a Proposition be affirmative, it must necessarily be a false one, if there be no Identification between the extremes of it.

By this discourse, we have found two sorts of Propositions, which beget knowledge in us. One, where the Identification of the extremes is of it self so manifest, that, when they are but explicated, it needs no further proof: The other, where though in truth they be Identifi'd, yet the Identification appears not so clear, but that some Discourse is required to satisfy the understanding therein. Of the first kind are such Propositions, as make one of the extremes the Definition of the other, whereof it is affirm'd: as when we say, A man is a reasonable Creature; which is so evident, if we understand what is meant by a Man, and what by a Reasonable Creature, as it needs no further proof to make us know it. And knowledge is begotten in us, not only by a perfect Identification of the extremes, but as well by an imperfect one: as when what is said of another is but part of its definition; for example, if one should say, a man is a creature, no body that knows him to be a rational creature, (which is his complete definition) could doubt of his being a creature, because the being a Creature is partly Identifi'd to being a rational creature. In like manner, this obvious evidence of Identification, appears as well where a compleat Division of a thing is affirm'd of the other extreme, as where that affirmation is made by the totall or partial Definition of it: as when we say, *Number is Even or Odd, an Enunciation is True or False*, and the like; where, because what is said comprises the differences of the thing whereof it is said, 'tis plain that one of them must needs be that, whereof we speak.

Peradventure some may expect, that we should give Identical Propositions (among others) for examples of this plain evidence: but because they bring no acquisition of new knowledge to the Soul; (the doing of which, and reflecting on the manner, is the scope of this Chapter) I let them pass without



out any further mention; having produced them once before, only to shew, by an undeniable example, what it is that makes our Soul consent to an enunciation, and how knowledg is begotten in her, that we might afterwards apply the force of it to other Propositions.

Let us therefore proceed to the second sort of Propositions; which require some Discourse, to prove the Identification of their Extrems. Now the scope of such Discourse is, by comparing them to some other third thing, to shew their Identification between themselves; for it shews, that each of them apart is identified with that new subject it brings in: and then our understanding is satisfied of their identity, and our Soul secure of that knowledg it thus acquires; as well as it is of that which results out of those Propositions, which bear their evidence in their first aspect.

This negotiation of the understanding, to discover the truth of Propositions when it is somewhat hidden, (which we call Discourse), as it is one of the chiefest & noblest actions of the Soul. So it challenges a very heedful inspection into it, and therefore we will allow it a peculiar Chapter by it self, to explicate the nature and particularities of it. But, this little we now have said concerning it is sufficient for this place; where all we aim at is, to prove (and, I conceive, we have done it very fully) that when Identity between two or more things Presents it self to our understanding, it makes & forces knowledg in our Soul.

Whence is manifest, that the same power or Soul, which, in a *Single Apprehension* is possessed with the Entity or Unity of it, is that very power or Soul, which, apply'd to Enuntiation, knows or deemes: knowing is nothing else, but the Apprehending of manifest Identity in the extrems of Proposition, or an effect immediately consequent out of it, in the Soul that applies it self to apprehend that Identity. Which apprehension is made, either by the force of the extrems, apply'd immediately to one another; or else by the application of them to some other thing, which peradventure may require yet a further application to new apprehensions: to make the Identity between the first extrems appear evidently.

Now, as when Identity, truly appears, it makes evidence to our understanding, and begets assured knowledge in our

C c c

Soul;

6.  
How Opinion  
is begotten in  
the Under-  
standing.



Soul: so, when there is only an apparent Identity, but not a real one, it happens that the understanding is quieted without evidence; and our Soul is fraught with a wrong or slight belief, instead of certain knowledg. As for example, 'tis for the most part true, that what Wise Men affirm is so as they say: but, because wise men are but men (& consequently, not infallible), it may happen that, in some one thing, the wisest men that are may miss; though, in most, & generally speaking, they hit right. Now if any one in a particular occasion should (without examining the matter) take this proposition rigorously and peremptorily, *that* What wise men affirm is true, and ther upon subsume with evidence, *that* Wise men say such a particular thing; and should thence proceed to believe it: in this case he may be deceiv'd, because the first proposition is not verily, but only seemingly, evident.

And this [is the manner, *how* that kind of deeming, which is either opposed or inferiour to knowledg, is bred in us: to wit, when, either through temerity (in such cases where we may, & it is just we should examine all particulars so carefully that no equivocation or mistake in any part of them be admitted to pass upon us for a truth; & and yet we do not), or else through the limitedness & imperfection of our nature, when the minuteness & variety of petty circumstances in a business is such, as we cannot enter into an exact examination of all that belongs to that matter, (for, if we should exactly discuss every slight particular, we should never get through any thing of moment), we settle our understanding upon grounds that are not sufficient to move & determine it. Now, in some of these cases, (& particularly in the later) it may happen, that the understanding it self is aware that it neither hath discover'd, nor can discover evidence enough, to settle its assent with absolute assurance: and then it judges the belief it affords such a proposition, to be but probable; &, instead of knowledg, hath but opinion concerning it. Which Opinion appears to it more or less probable, according as the motives it relies on are stronger and weaker.

7.  
How Faith is  
begotten in  
the understand-  
ing.

There remains yet another kind of deeming for us to speak of: which, though it ever fail of Evidence, yet sometimes 'tis better than Opinion; for sometimes it brings certitude with it. This we call Faith; and it is bred thus: when we meet with



with a man who knows something we do not; if withal we be perswaded that he neither doth, nor will tell a lye, we then believe, what he saith of that thing to be true. Now, according to the perswasion we have of his knowledge and veracity, our belief is strong, or mingled with doubt. So that, if we have absolute assurance and certainty that he knows the truth and will not lye; then we may be assured, that the faith, we yield to what he saith, is Certain; as well as Evident Knowledge is Certain, and admits no comparison with Opinion, be it never so probable. But so it may happen, that we may be certainly assured that a man knows the truth of what he speaks; and that he will not lye in reporting it to us: for, seeing no man is wicked without a cause, & that to tell a lye in a serious matter is a great wickedness; If once we come to be certain that he hath no causes as it may, fall out we may then it follows that we are assured of the thing which he reports to us.

Yet still such *Faith* falls short of the evidence of knowledg; in this regard, that its evidence sticks one degree on this side the thing it self, and at the push, in such a case we see but with anothers eyes: and consequently, if any opposition arise against our thought therabout, 'tis not the beams and light of the thing it self, which strengthen us against such opposition, but the goodness of the party upon whom we rely.

Before I goe any further, I must needs remember one thing, that our Masters teach us: which is that *Truth* and *Falshood* are first found in Sayings or Enuntiations; and that, although Single Apprehensions are in our mind before these judgments; yet are they not *true* or *false* themselves, nor is the understanding so by them. To comprehend the reason of this maxime, let us consider what *truth* and *falshood* are. Surely, *Truth* is nothing else but the conformity of the understanding with the things that make impression upon it; and consequently, *Falshood* is a disagreeing between our mind and those things: If the Existence which the things have in us be agreeable to the Existence they have in themselves, then our Understanding is true; otherwise it is false. Now, the natural perfection of our Soul or understanding is, to be fraught with the rest of the whole World, that is to have the knowledge of all things that are; the knowledg of their essences, natures, proprieties, operations, and of what-

8.

Why *Truth* is the perfection of a Reasonable Soul: and why it is not found in Simple Apprehensions as well as in Enuntiations.



ever else belongs to them all in general , and every one in particular : but our Soul cannot be stored or fraught with any thing, by other means then by her assent or deeming : whence it follows, that she cannot have her perfection till her deemings or judgments be perfect, that is be agreeable to things in the world : when they are so, then are they true. And this is the reason why Truth is the aim and perfection of the Soul. Now then, truth residing only in the assents and judgments of the Soul, (which are the traffick wherby she enriches her self with the rest of the world ) : and they being framed, by her discerning an Identity between two things ; which she expresses by affirming one of them of the other : it follows, that nothing can be true or false, but where there is a composition of two extrems, made by the ones being affirm'd of the other ; which is done only in Enunciations or judgments. Whiles Single Apprehension assent to nothing, and therefore settle no knowledge in the Soul ; and consequently are not capable of verity or falsity : but are like Pictures made at fansie, some one of which may happen to be like some Person ; but cannot be said to be the Picture of him, because it was not drawn, from him. So, these bare Apprehensions, because there is not in them an union of the Soul to the outward world, or to the Existence which actuates its object ; therefore they make not the Soul to be the image of the things existent : but the Judgment, which still takes a thing existent, or as existent, in the Subject of the Proposition, draws its Picture from the thing it self ; and therefore makes the Soul to be well or ill painted in respect of the thing, that is, true or false.

And this is the reason why, in one sense, doubtful propositions, which the understanding (not being yet resolv'd) makes inquiringly, to inform it self of the truth of them, cannot be said to be true or false : for, all that while, the Soul yeilds no assent to them, either one way or other. Yet in another sense, they may, which is, taking them as subjects that the understanding determines to it self to treat of : for there being two extrems in them, and the proposition consisting in this, whether these extrems be Identified or no ; it follows, that, since one part must of necessity be, such a proposition, spoken at random or written by chance without design, is of necessity either  
true



true or false, according as the extremes of it are or are not one thing.

There occurs no more to my consideration to be said in this place, concerning the assents and judgments of the mind: unless it be, to explicate, in a word or two, the several qualities of them, which are found in several Persons; and to point at the reason why they are call'd by those names, which they are universally known by. To which purpose we may observe, that judgment or deeming being a quieting of the mind; it follows that the mind must needs be at disquiet and unrest, before it comes to judgment: so that we may conclude, judgment or thinking is a good attain'd by a former motion. Now, according to the quality of this motion, the judgment or assent is qualify'd and denominat'd. We must therefore consider what belongs to motion; which when we have done, we shall in judgments find something proportionable thereto.

We know there is a begining and ending in motions; and that there are parts by which it is drawn out in length: all which must be particularly consider'd, in our comparing of motions to judgments. Now then, as he that would know precisely the nature of any motion, must not begin his survey of it, after it hath been some time in flux, nor give over his observing it, before it have arriv'd to its utmost period; but ought to carry his intention along from its first origine, and pass with it through all its parts; till it ceasing, give him leave to do so too, (for otherwise, it may happen that the course of it be differing in those parts he hath not observed, from those that he hath; and accordingly, the picture he shall make of it, by that imperfect scantling, will prove an erroneous one): so, when a man is to make a judgment of any matter in question, to give a good account of it, he must begin at the root, and follow successively all the branches it divides it self into, and drive every one of them to their utmost extremity and period; and according as in judging he behaves himself well or ill, in the several circumstances that are proportionable to the begining, ending, and parts of motion, so his judgment is qualified with the names of several virtues agreeing thereto, or of their opposite defects.

9.  
What is a solid judgment, and what a slight one.



If he begin his considerations very low, and from the very bottom and root of the affair, (which is, from the first and all comprehending principles of the question) and proceed on orderly, taking all before him; his judgment is accounted deep, profound, and solid: for he that casts so far, as to leave behind him no part of the matter he is inquiring about, and then drives his course steadily and smoothly forwards, without any leaps over rugged passages, or interruptions, or loose breaches, must of necessity make a well grounded judgment; and such an one, as cannot easily be overthrown, or be easily removed from it.

And this is indeed the full reason of what, a little above, we only glanced at: namely, why Understanding Men are usually accounted obstinate in their *tenets*, and are hard to be removed from opinions once settled in their minds. For, when other men oppose them, they urge nothing (for the most part) against these judicious mens resolutions or beliefs, but what they have already thoroughly foreseen; but these, on the other side, see a great deal, that their opposers reach not to: so that, notwithstanding all such opposition, they continue still unshaken in their judgments; for which, the others, which see not as much as they, think them obstinate and not led by reason, because they follow not that short reason, beyond which themselves cannot reach.

The contrary vice to this is called a slight judgment; and consists herein, that a man, out of a few and insufficient number of circumstances, resolves the whole case: which temerity and short sightedness of judgment is significantly taxed in our English Proverb, that A fools Bolt is soon shot.

10.  
What is an  
acute judgment, and  
what a dull  
one.

Thus much for the Beginning of a Judgment: the next consideration may be concerning the End of it. In regard wherof, if it reach to the utmost extent and period of what is considerable in a hard question proposed, it gains the title of sharp, or of subtle, and acute: for, the hardness of the matter, that perplexes ones judgment, consists in the involution of things; which, look'd upon in gross, seem to have no distinction or opposition among themselves, and yet are in truth of very different and contrary natures. Now, a good judgment divides and cuts through them, and allots to every particular thing its proper limits and bounds: wherfore, as in corporeal substances



ces, the vertue of dividing is sharpness and edge; by translation from thence, such a judgment, as pierces neatly and smartly between contradictories that lie close together, is called sharp and acute. In like manner, subtilty is a vertue, wherby a liquor or other body searches every little hole, and part of what it works upon, till it get through it; and from thence, it is used in judgments to signifie the same: whose opposite vice is called dulness.

In the last place we are to examine, what proportion a judgment holds with the parts of motion. In these, two things are to be considered; namely, the quantity or multitude of those parts, and the order of them. As for the quantity in a motion, it belongs either to long or short, or to quick and slow. Now, where the beginning and ending are already known and determin'd, and consequently the length is determin'd and depends not at all of the Judg to alter it, (for he must take it as the matter gives it); there a judgment can acquire no denomination of perfection or deficiency, from length or shortness, (for, they belong originally to the matter of the judgment; and the judgment must accordingly fit it self to that; and therefore is liable neither to commendations nor reproach, for being long or short): It remains then, that the vertue in judging, answerable to the quantity of motion, must consist in *quickness* and *celerity*; and the contrary vice, in *slowness* and *heaviness*.

As for order in the several parts of motion; we know that, if they be well order'd, they are distinct and easily discernable: which vertue, in our subject, is called clearness of judgment; as the contrary vice is confusion.

III.  
In what consists quickness and clearness of judgment: and their opposite vices.



## CHAP. III.

## Of Discoursing.

1.  
How discourse  
is made.

**I**N the last Chapter we have shew'd, how two Apprehensions joyn'd together make a Judgment: How, in this our first employment will be, to shew how three of these thoughts or Judgments, well chosen and duly order'd, compose the first and most simple of perfect discourses, which Logicians call a *Syllogism*, whose end and effect is, to gain the knowledge of something, before, hidden and unknown. The means wherby this is compassed, is thus. By the two first Judgments, we joyn the extremes of the proposition we desire to know to some third thing; and then, by seeing that they both are one third thing, and that one can be but one, we come to discern that truly one of them is the other; which before we saw not. So that the Identity, which first made an Identical proposition be known and agreed to, and afterwards caused the like assent to be yielded to those maxims whose Identification presently shew'd it self; now, by a little circuit and bringing in of a third term, makes the two first (whose Identification was hidden and obscure, whiles we look'd upon the terms themselves) appear to be in very truth but one thing.

2.  
Of the Figures  
and Moods of  
*Syllogisms*.

The various mingling and disposing of these three terms, in the two first propositions, begets a variety in the *Syllogisms* composed of them: and it consists in this, that the assumed term, to which the other two are interchangably joyn'd, is either said of them, or they of it. And, from hence spring three different kinds of *Syllogisms*; for, either the assumed or middle term is said of both the other two, or both they are said of it, or it is said of one of them, and the other is said of it. Nither is there any deeper mystery than this in the three figures, our great Clerks talk so much of: which being brought into Rules, to help our memory in the ready use of this transposition of the terms, if we spin our thoughts upon them into over small threds, and therof weave too intricate webs (mean while not reflecting upon the solid ground within our selves, wheron these rules are built, nor considering the true end why,) we



we may spend our time in trivial and useless subtilities; and, at length, confound and misapply the right use of our natural discourse, with a multitude of precepts drawn from artificial Logick.

But, to return to our matter in hand. Under this primary threefold variety is another of greater extent, growing out of the divers composition of the three terms, as they are qualified by affirmation or negation, and by universality or particularity: for, that unity, which the two terms, whose Identification is enquired after, must have by being joyn'd with the third, becomes much varied by such divers application; and from hence shoots up that multitude of kinds of Syllogisms, which our Logicians call *Moods*. All which I have thus particularly expressed, to the end we may observe how this great variety hangs upon the sole string of Identity.

Now, these Syllogisms, being as it were interlaced and woven one within another, ( so that many of them make a long chain, wherof each is a link ) breed, or rather are, all the variety of mans life. They are the steps by which we walk in all our conversations and businesses. Man, as Man, doth nothing else, but weave such chains; whatever he doth, swerving from this work, he doth as deficient from the nature of man: and if he do ought beyond this by breaking out into divers sorts of exterior actions, he findes nevertheless, in this linked sequel of simple discourses, the art, the cause, the rule, the bounds, and the model of it.

3.  
That the life  
of man, as man  
consists in Dis-  
course; and  
of the vast ex-  
tent of it.

Let us take a summary view of the vast extent of it; & in what an immense Ocean one may securely sail, by that never varying Compass, when the needle is rightly touch'd, and fitted to a well moulded box: making still new discoveries of regions, far out of the sight and belief of them, who stand upon the hither shore. Humane Operations are comprised under the two general heads of Knowledge and Action: if we look but in gross upon what an infinity of divisions these branch themselves into, we shall become giddy, our brains will turn, our eyes grow weary and dim, with aiming only at a suddain and roving measure of the most conspicuous among them, in the way of knowledge.

We see what mighty works men have intended their labours



to not only by wild discourses, of which huge volums are composed, but even in the rigorous method of *Geometry*, *Arithmetick*, and *Algebra*; in which, an *Euclide*, an *Apollonius*, an *Archimedes*, a *Diophantus*, and their followers, have reach'd such admirable heights, and have wound up such vast bottoms. Somtimes shewing by effects, that the thing proposed must needs be as they have set down, and cannot possibly be any otherwise; otherwhiles, appaying the understanding (which is never truly at rest, till it hath found the Causes of the effects it sees) by exposing how it comes to be: so that, the Reader, calling to mind how such a thing was taught him before, and now finding another unexpectedly convinced upon him, easily sees that these two put together make and force that third to be, wherof he was before in admiration how it could be effected; which two ways of discourse are ordinarily known by the names of Demonstrations, the one called *a priori*, the other *a posteriori*.

Now, if we look into the extent of the deductions out of these, we shall find no end. In the Heavens, we may perceive *Astronomy* measuring whatever we can imagine; and ordering those glorious lights which our Creatour hath hang'd out for us, and shewing them their ways, and picking out their paths, and prescribing them (for as many ages as he pleases before hand) the various motions they may not swerve from in the least circumstance. Nor want their Sublime Souls, that tell us what metal they are made of, what figures they have, upon what pillars they are fixed, & upon what gimals they move and perform their various perious; witness that excellent and admirable work, I have so often mention'd in my former Treatise. If we look upon the Earth, we shal meet with those that will tell us how thick it is, and how much room it takes up: they will shew us how Men and Beasts are hang'd to it by the heels; how the Water and Air covers it; what force and power Fire has upon them all, what working is in the depths of it; and of what composition the main body of it is framed, where neither our eys can reach, nor any of our Senses sends its messengers to gather and bring back any relations of it. Yet are not our Masters contented with all this; the whole world of Bodies is not enough to satisfy them: the knowledg of all corporeal



real things, and of this machine of heaven and earth, with all that they enclose, cannot quench the unlimited thirst of a noble mind, once set on fire with the beauty and love of Truth.

*Æstuat infœlix angusto limite mundi,  
Ut Gyrae clausus scopulis, parvaque Seripho.*

But, such heroick spirits cast their subtile nets into another world, after the winged inhabitants of the heavens; and find means to bring them also into account, and to serve them (how imperceptible soever they be to the senses) as dainties at the Souls table. They enquire after a Maker of the world we see, and are our selves a main part of: and having found Him, they conclude Him (out of the force of contradiction) to be Eternal, Infinite, Omnipotent, Omniscient, Immutable; and a thousand other admirable qualities they determine of him. They search after his Tools and Instruments, wherewith he built this vast and admirable pallace; and seek to grow acquainted with the Officers and Stewards, that under him govern this orderly and numerous Family. They find them to be Invisible Creatures exalted above us more than we can estimate; yet infinitely farther short of their and our Maker, than we are of them. If this occasion them to cast their thoughts upon Man himself, they find a nature in him ('tis true) much inferiour to these admirable Intelligences: yet such an one, as they hope may one day arrive to the likeness of them; and that, even at the present, is of so noble a mould, as nothing is too big for it to fathome, nor any thing too small for it to discern.

Thus, we see, knowledg hath no limits; nothing escapes the toils of Science: all that ever was, that is, or can ever be, is by them circled in; their extent is so vast, that our very thoughts and ambitions are too weak, and too poor to hope for or aim at, what by them may be compassed. And, if any man, that is not inured to raise his thoughts above the pitch of the outward objects he converses daily with, should suspect what I have now said, is rather like the longing dreams of passionate Lovers, whose desires feed them with impossibilities, than that it is any real truth, or should imagine it but a Poetick *Idea* of Science, that never was nor will be in act; or if any other, that hath his discoursing faculty vitiated and per-



perverted, by having been imbued in the Schools with unsound and umbratile principles, should perswade himself, that, however the pretenders to learning and Science may talk loud of all things, and make a noise with Scholastick terms, and perswade their ignorant hearers that they speak and unfold deep mysteries, yet, in very truth, nothing at all can be known: I shall beseech them both to suspend their conjectures or beliefs herein, and to reserve their censure of me, whether or no, I have strain'd too far, till the learned Author of the *Dialogues of the World* hath enriched it with the Work he hath composed of *Metaphysicks*; in which, going orderly and rigorously by continued propositions, as Mathematicians demonstrate their undertakings, he hath left no scope for wrangling brains to make the least cavil against his doctrine, and, casting his sharp-sighted thoughts over the whole extent of nature, and driving them up to the *Almighty Author* of it, he hath left nothing out of the verge of those rules and all-comprehending principles he gives of true Science. And then I doubt not, but they will thoroughly absolve me, from having used any amplification, in aiming at the reach of this all grasping power. For my part, the best expression I am able to make of this admirable piece, I must borrow from witty *Galileus*, when he speaks of *Archimedes's* long miss'd Book of *Glasses*; and profess, that, having some of the Elements or Books of it entrusted in my hands by the Author, I read them over with extreme amazement, as well as delight, for the wonderful subtilty and solidness of them.

3.  
Of humane  
actions; and of  
those that con-  
cern our selves.

Thus much for knowledge. Now let us cast an eye upon humane actions. All that we do (if we do it as we should, and like men) is govern'd and steer'd by two sorts of qualities: the one of which, we call Arts; the other, Prudence. An Art is a collection of general rules, comprehending some one subject, upon which we often work. The matters we work on (out of which the particular subjects of Arts do spring) are of three kinds: our Selves, our Neighbours, and such dumb or insensible things as compose the Rest of the World.

Our actions on our Selves are the highest and noblest of all the rest, and those by which we live and work as men: or, (to express my self better) they are those by which we perfect  
that



That part of us, which makes us men ; and by which we direct and level all we do, according to the rule of reason, not suffering our actions to swerve from what she dictates to us. This is done, by multiplying and heightning the thoughts of those things, which maintain us in reason ; whether the motives be moral (as, the examples of worthy persons, and the precepts and perswasions of wise men, and the like) or natural, (as, the consideration of the sweet and contented life, which vertue gives us here, by good conversation, honour, profit, quiet, pleasure, and what else soever grows out of so excellent a root: ) as also, of the Beatitude and Happiness it brings us to in the next state ; and of the contrary effects which spring from vice. Again, by observing the motives and wayes of our passions and animal desires, we learn how to prevent them, how to terrifie them, and how to wear them away by little and little, through sometimes giving them diversions, otherwhiles restraining them with moderation, and oftentimes cutting off the occasions, and abridging them of their natural encreasings. All these things are brought into art and rule ; whose lessons were men but as careful and industrious to study, as they are to become masters in vain and trivial things, they would enjoy happy lives.

In the next place, we are to consider the actions wherby we work upon our Neighbours. They are chiefly government and negotiation : both which are of one kind ; and have but this difference, that the one is done in common, the other is perform'd in particular. The means by which we command are rewards and punishments ; which who hath in his hands may assuredly, by wise using them, bring to pass whatever he has a mind to.

Upon occasion of mentioning these two powerful motives, which have so main an influence in mens actions, we may note by the way, that many of them, (and that work most forcibly upon mens minds) are things whose subsistence we know not where to find ; as honour, praise, glory, command, singularity, eminency, shame, infamy, subjection, reproach, and the like : to any of which none of our senses can reach ; and yet they govern mans life, in a manner wholly and perfectly.

In negotiation, we propose to single men their own interests and profits ; not such as the proposer can or will effect ; but  
such

5.  
Of humane  
actions, as they  
concern our  
neighbours.



such as are likely to arise out of the action we endeavour to draw him to with whom we treat. In both these, the usual labour is, to make our neighbours willing to leave some present good, in hope of a greater to come; or to be content to undergo some present harm, for fear of a greater to ensue. The general instrument which we use is Discourfing; whose vertue consists partly in our own mind, and partly in delivering our mind to others: for, first we must know what we should say, and next in what manner we should say it.

6.  
Of Logick.

The art which directs our own mind, and teaches us what to say, is Logick: whose parts are two; according as the affairs falling into discourse are, likewise of a twofold nature. The one instructs us how to manage and order our reason, when it deals with such subjects as we may attain to Certainty in: and here the rules of Demonstration take place; teaching us to *define*, to *divide*, and to *conclude*. The other instructs us how to behave our selves when we meet with such subjects, as a good and probable *guesse* is the furthest we can reach to towards the knowledge of them: and for these the Topical part of Logick serves; which, taking a view of all the Accedents belonging to any thing propounded, shews how to draw probabilities from every of them.

7.  
Of Grammar.

Our discoursing to others is either to open our minds barely to them, or to perswade them of somewhat our selves believe, or to win them to somewhat we would have them do. For the bare delivery of our minds to others, we have Grammar; the scope of which art consists; first, in teaching us to deliver our conceptions plainly and clearly, (which is the main intent of speaking), next, in making our discourse be succinct and brief, (which is the measure of our speaking, both for our selves and others), and lastly, in sorting our words so as what we say may be accompanied with sweetness both in common, in regard of the ear, by avoiding such harsh sounds as may offend it, and in particular, in regard of the custom of the language we speak, and of the persons to whom we speak.

8.  
Of Rhetorick.

The art whereby we may perswade others, and win them to assent to what we would have them, is Rhetorick or Oratory. Her rules instruct us how to dispose and order with best advantage,



tage, in regard of the Auditors disposition, both the reasons which Logick affords us, and the words which Grammar stores us with : as also, how to give life and motion to what we say by our action and gesture ; that so we may perswade our Auditory such passions reign in us, as we seek to stir up in them. For, as we may observe, that one who yawns makes another likewise yawn, and as our seeing others laugh provokes laughing also in us (the reasons whereof we have touch'd in the former Treatise) : after the same manner, what passion soever we exhibite in our selves, the same steals insensibly upon those we speak to ; while their mind, attending to the words they hear, is not aware of the subtile spirits motions that, by a kind of contagion, rise and swell in their hearts. According to which natural inclination in all men, the Master of Poets, and excellent observer of mens humours, said passing well

*Si vis me flere, dolendum est*

*Primum ipsi tibi :*

Horat. de  
Art. Poet.

Hence grow those encreases by Metaphors, Hyperboles, and other Tropes and Figures : hence those fervors by Interrogations, Exclamations, Apostrophes, and the like ; which, when they are fitly placed, carry the Auditor even against his will.

Poetry is not a governour of our actions ; but by advantageous expressing some eminent ones, it becomes an useful direction to us, and therefore challenges a place here. The delight of it is, by representing humane actions in a more august and admirable hew, than in themselves they usually have, to frame specious *Ideas* ; in which the people may see what is well done, what amisse, what should be done, and what by error is wont to be done : and to imprint in mens minds a deep conceit of the goods and evils, that follow their vertuous or vicious comportment in their lives.

9.  
Of Poetry.

If those who assume the title of Poets did aim at this end, and would hold themselves strictly to it, they would prove as profitable instruments as any the Commonwealth had : for, the delightfulness and blithness of their compositions invites most men to be frequently conversant with them, (either in Songs, or upon the Stage, or in other Poems) ; while the sober aspect and severity of bare precepts deturn many from lending a pleased

ear



ear to their wholesome doctrine; and, what men swallow with delight, is converted into nourishment. So that, if their drift were to settle in mens minds a due valuation of vertue, and a detestation of vice; no art would do it more universally, nor more effectually: and by it, mens hearts would be set on fire to the pursuit of the one, and be shrunk up with dislike and horror against the other. But, to such a Poet as would aim at those noble effects, no knowledg of Morality, or the nature and course of humane actions and accidents must be wanting: he must be well versed in History, he must be acquainted with the progress of nature, in what she brings to pass, he must be deficient in no part of Logick, Rhetorick, or Grammar; in a word, he must be consummate in all arts and Sciences, if he will be excellent in his way.

10.  
Of the power  
of speaking.

But while we thus entertain our selves with those arts, which serve us in discoursing with others, it were a great oversight to forget that faculty, which is the basis and ground-work of all those: and, that is the power of *speech*, which nature hath bestow'd on us. It consists in two actions: the one outward, the other inward. The outward is the giving of various sounds to our breath, as it passes through our mouth, by diverse conjunctions of our tongue, teeth, and lips, to themselves, or to divers parts of our mouth, or by their separations from them; in which, we see that Birds are able to imitate us; and I am perswaded, the like might be effected by insensible creatures, if a dexterous man would employ his time, in contriving and making an instrument to express those different sounds; which, not having more than seven substantial differences besides the vowels, (as some who have carefully noted them affirm) it would peradventure be no hard matter to compose such an engine.

The inward action of locution is the framing of convenient answers to what is asked, of fit replies to what is said; and, in a word, to speak oppositely and to the purpose: whereto, neither Beast nor dead Instrument can be brought; unless the Artificer be able to endue it with understanding.

11.  
Of arts that  
concern dumb  
and insensible  
creatures.

All other arts instruct us how to work orderly upon beasts and insensible bodies: By some of them we cultivate living creatures; as when Husband-men nourish sheep, oxen, fowl, and the like, for slaughter: by others, we discipline them; as when we teach



reach Horses, Dogs, Apes, Hawks, Parrats, and some kind of Fishes, to hunt, to play, and in a word, to do somewhat either for our profit, or for our pleasure: and again, by others, we use their natures to our end; as when we lay baits to catch them, when we set eggs under hens to have the chickens, and the like. By other arts, we work as powerfully upon insensible creatures; among which, by knowing the natures of divers Trees, Herbs, Minerals, &c. we are able to bring any of them to what use soever we find most expedient for our service. From hence grow all those Arts and Trades, in which we see men daily spend their whole lives; so as it is needless to insist upon the particulars of them, since Towns and the Cities are composed of the several Tribes of persons that profess and live by them.

But, we must not leave this subject, without noting how admirably mans wit turns it self to so different sorts, and to such an infinite variety of things. For, what man is there, (if he be a man) but might have become Master in any of these so differing Trades; in cause he had apply'd himself as constantly to that, as he hath done to some other, he is perfect in? Again, let us consider how it happens often, that he doth not the same thing twice the same way; but according to his own or another mans fantasie, changes his work at will: now doing it after one fashion, now after another; as having no law or determination from nature, but being wholly left to his own direction.

There remains one art, not yet spoken of, which knows not where to challenge a place) whether among the Moderatours of our own actions, or among those wherby we govern things); and that is Arithmetick: which seems to belong to things, and yet it medles not with them; and again, it seems to be a main directour of our internal actions, and yet belongs neither to Morals, nor to Logick. Wher'so're its due be, to be placed, I am sure its not to be forgotten; seeing it is so principal an one, as our life can hardly consist without it. It works upon notions that are no where; for every thing that is in the World, is but one: & to be, or to make a number, cannot happen without an understanding. The affections likewise of them are, as the subject, all invisible; as, to be even or odd, to be cubes, squares, roots, &c. and yet how great the power and extent of this

D d d

12.  
Of Arithme-  
tick.



art is none can rightly understand or believe, but he that hath the knowledge, or hath seen the vertue and efficacy of it.

13.  
Of Prudence.

All these arts consist in common rules, which require the second of those qualities, wherby we said humane actions are govern'd, to apply them to their particular matter; and that is Prudence: which we may define to be a quality or power, by whose assistance we apply to the matter we are to work on such Instruments, as in our present judgment appear fittest to bring it to that pass which serves best for our intentions; when, by our senses or other guesses, we know the particular dispositions of the matter, and of the Instruments wherewith we are to change it. Now, although this occurs generally in all *Arts*, yet its special place and necessity is in governing and moderating our own, or other mens Moral actions: and accordingly, its name is especially addicted therto; and that man is said to be prudent or discreet, who governs himself and others well.

This quality of Moral Prudence, in general, is divided into three particular ones: the first of which belongs to a Governor in a State or Commonwealth: the next may be assign'd to him that is skilful in the Laws: and the third concerns the managing and conduct of Military actions. The reason of this long-receiv'd distribution peradventure is, because, in these occurrences, our passion sways us generally more than in any others: and, the operation and effect of Prudence (whose Province is to curb and moderate our Passions by Reason) is greatest, and appears most, in those subjects, where Passion reigns usually with greatest impetuosity.

14.  
Observations  
upon what  
hath been said  
in this Chap-  
ter.

Thus have we run over the main parts of discourse, and the general heads of mans action as Man: which peradventure may, through their numerousness, appear to be, as it were, but loosely scatter'd from our pen, (as happens to all materials, that must serve for after buildings, and that, till they be employ'd, require no more but sorting, and laying together in several heaps, to the end they may be ready for use); and therefore, before we go any further, it will not be amiss to make reflexions on what we have said, and to draw it nearer our intended scope, and to square out and give some figure and polishing



polishing to these stones here, where we dig them out of the quarry, wherby they may hereafter, with less ado, fit the places we have assign'd them in the structure we intend. And so, a little trouble here, while our tools are still in our hands, and our matter lyes ready for our strokes, and our thoughts are warm with working upon them, may save us a great deal there, where our main imployment will be, to lay artificially, and to joyn closely, what now we but hew out; and therefore will require finer instruments, and a sharper edge, than what at present serves our turn.

Let us then bring back to account all we have said in this Chapter: and, when we have well reflected upon every particular, we shall find they all agree in this, that they are nothing else but a due Ordering of one thing with another. A Syllogism is an Ordering of some few Notions; a Science is an Ordering of Syllogisms, so as a new Proposition may follow out of those which went before: and as we see that, when in our thoughts divers Syllogisms are well-order'd, hidden things come to be disclosed in our understanding; even so among bodies, if things, whose proprieties are known, be likewise Order'd and put together, those very Effects, which were discover'd by the Ordering of Notions in our Head, will spring forth in Nature. As for example, if, by knowing the natures of fire and tow, our discourse finds that tow put to fire will presently become fire; the same will happen in nature, if we put material tow, or some other body that hath the qualities of it, to real fire, or to some other substance that is endew'd with the vertues of fire. In like manner, if, by knowing that Colours are nothing else but various mixtures of light and of darkness in bodies, our Discourse assures us, that, by several compoundings of these extreams, Reds, Blews, Yellows, Greens, and all other intermediate colours may be generated: accordingly we shall find in effect, that, by the several minglings of black and white bodies (because they reflect or drown light most powerfully) or by interweaving streams of pure light and shadows one with another, we may procreate new colours in bodies, and beget new luminous appearances to our eys. So that hence it appears clearly, that the same nature is in our Understanding, and in the Things: and that the same Ordering, which in



the one makes Science, in the other causes natural transmutations.

Another reflexion, which will be fit for us to make upon these long discourses, is this, that of necessity there must be a joyning of some things, now actually in our knowledg, to other things we think not of. For it is manifest, that we cannot at the same time actually think of a whole book of *Euclide*; and yet, to the due knowledg of some of the last Propositions, the knowledg of almost all the former is required: likewise it is impossible we should at the same time think of all the multitude of rules belonging to any Art, as of Grammar, of Metering, of Architecture; and yet, when we write in Latine, make a Poem, or lay the design of a House, we practise them whiles we think not of them, and are assured we go not against them, however we remember them not.

Nay, even before we know a thing, we *seem* to know it: for since we can have a desire of nothing but of what we know; how could we desire to know such or such a thing, unless we know both it and the knowledg of it? And for the most part we see a horse, or man, or herb, or workmanship; and by our sense have knowledg that such a thing it is, before we know what, or who, or how, it is: That grows afterwards, out of the diligent observation of what we see: which is that, wherby learned men differ from the unlearned. For, what strikes the sense is known alike by them both: but then here is the difference between them, the latter sort sits still with those notions, that are made at first by the beating of our sense upon us, without driving them any further; and those that are learned resolve such compounded notions into others made by more common beatings, and therefore more simple: and this is all the odds in regard of knowledg, that a Scholar has of an unletter'd man.

One observation more we will draw out of what we have said, and then end this Chapter: it is, how a man oftentimes enquires among his own thoughts, and turns up and down the images he hath in his head, and beats his brains; to call such things into his mind as are useful to him, and are for the present out of his memory. Which as we see so necessary, that without it no matter of importance can be perform'd in the way  
of



of discourse, (wherof I my self have too frequent experience in writing this Treatise :) so, on the other side, we cannot perceive that any creature, besides Man doth it of set purpose and formally, as man doth.

## CHAP. IV.

*How a man proceeds to Action.*

**H**AVING thus taken a summary view of the principal Qualities a man is endued with, Apprehending, Judging, and Discoursing, and shew'd how he is enrich'd in and by them, with the natures of all things in the world : it remains for our last work in this part, to consider, in what manner he makes use of this treasure in his ordinary Actions : which, 'tis evident are of two different kinds, and consequently have two several principles *Understanding* and *Sense*; they sway by turns, and somtimes joyn together, to produce a mixed action of both.

If only *Sense* were the fountain from whence his actions spring, we should observe no other strain in any of them, than meerly that according to which Beasts perform theirs : they would proceed evermore in a constant unvariable tenour, according to the law of material things ; one body working upon another, in such sort as we have declared in the former Treatise.

On the other side, if a man were all *Understanding*, and had not this bright lamp enclosed in a pitcher of clay ; the beams of it would shine without any allay of dimness, thorough all he did : and he could do nothing contrary to reason, in pursuit of the highest end he hath prefix'd unto himself. For, he neither would nor could do any thing whatever, till he had first consider'd all the particular circumstances, that had relation to his action in hand ; and had then concluded, that, upon the whole matter, at this time, and in this place, to attain this End, 'tis fitting and best to do thus or thus : which conclusion could be no sooner made, but the action would, without any further disposition on his side, immediately ensue ; agreeable to the

That humane actions proceed from two several principles, *understanding* and *Sense*.



principles it spring from. Both parts of this assertion are manifest. For the first, 'tis evident, that, whenever an Agent works by knowledge, he is unresolved whether he shall work or not work, as also of his manner of working, till his knowledg (that ought to direct and govern his working) be perfect and complete : but that cannot be, as long as any circumstance not-as-yet consider'd may make it seem fit or unfit to proceed : and therefore, such actions, as are done without exact consideration of every particular circumstance, do not flow from a pure understanding. From whence it follows, that, when an understanding is not satisfied of every particular circumstance, and consequently cannot determine what he must immediately do ; but apprehends that some of the circumstances not-as-yet consider'd, may (or rather must) change some part of his action ; he must of necessity be undetermin'd in respect of the immediate action ; and consequently, must refrain absolutely from working. The other part is clear, to wit, that when the understanding, upon consideration of all circumstances, knows absolutely what is best ; the action follows immediately (as far as depends of the understanding) without any further disposition on his behalf. For since nothing but knowledge belongs to the understanding, he who supposes all knowledg in it allows all that is requisite or possible for it to work by : Now, if all be put, nothing is wanting that should cause it to work : but, where no cause is wanting, but all requisite causes actually in being, the effect must also actually be, and follow immediately out of them : and consequently, the action is done, (in as much as concerns the understanding, and indeed absolutely, unless some other cause fail) as soon as the understanding knows all the circumstances belonging to it. So as it is manifest out of this whole discourse, that, if a man wrought only by his understanding, all his actions would be discreet and rational, in respect of the end he hath proposed to himself ; and, till he were assured what were best, he would keep himself in suspense and do nothing ; and, as soon as he were so, he would admit of no delays, but, at the instant, proceed to action according to his knowledg : the contrary of all which we daily see by experience in every man.

We



We may then safely conclude, that in humane nature there are two different centers, from whence cross actions flow : the one he hath common with beasts ; whose principles and laws we deliver'd in the former Treatise, where we discoursed of life, and the motions of life, and of passions : the other is the subject of our present enquiry ; which, in this place, expects at our hands that we should consider how it demeans its self, and what it doth in us, when by its guidance we proceed to any action. Experience must be our informer in general : after which, our discourse shall anatomise what that presents us in bulk. She gives us notice of three especial effects of our Understanding : First, that it Orders aright those conceptions which are brought to it ; Secondly, that, when they appear to be not sufficient for the intended work, it Casts about and seeks out others : and, Thirdly, that it strengthens those actions which spring from it, and keeps them regular, and firm, and constant to their beginnings and principles. To which last seems to belong, that it, sometimes checks its own thoughts, and brings back those it would have, and appears to keep, as it were, a watch over its own ways.

As for the Ordering of the present notions, 'tis clear that it is done by a secret dependance from the rules of discourse, and from the maxims of humane action. I call this dependance a secret one, because a man, in his ordinary course, makes use of those rules and *maxims* which serve his turn, as though they were instill'd into him by nature ; without so much as ever thinking or reflecting on them, to square out his actions by them : nay, some of them so far out of the reach of most men, as they cannot think of them, though they would, for they know them not. As, in particular, the rules of Discourse : the use of which is so necessary, as without it no man can converse with another, nor do any thing like a man, that is, reasonably. From whence then can this proceed, that so familiarly and readily a man makes use of what he is not conscious to himself that he hath any acquaintance with ? It can be nothing else, but that the Soul, being in her own nature order'd to do the same thing, which Scholars with much difficulty arrive to know what it is by reflection and study, and then frame rules of that afterwards to carry their discourse to a higher pitch : she, by an inborn vertue,

2.  
How our general and inbred maxims concur to humane action,



3.  
That the rules  
and maxims  
of Arts, work  
positively in  
us though we  
think not of  
them.

makes a man do it orderly, constantly, and certainly.

The like may be observ'd in the daily use men make of the *maxims* of humane actions; which are certain knowledges that formerly they have gotten, but usually think not of, while they work agreeably to them: yet it seems they work by them; for if their action should jar against any of them, they would presently reflect upon their *Maxime*, and by it correct what they were about. For example, one who is skill'd in the rules of Grammar, or of accenting his speech, or hath his ear used to Musick, while he hears true construction, or even verse, or consonant song, never reflects how it is made; or at most but considers in gross, that it is right: but, if a solecism or false quantity, or discord intervene; he presently is aware, not only that it is amiss, but remembers the very particular precise rule, against which the breach is made.

This at the first sight might occasion us to imagine, that the rules, by which any composition is made, work only negatively in us, while we are busie about it; that is, that they contribute nothing to the making of the thing, but only hinder us from committing errors: but, if we consider the matter well, we shall find it impossible, but that they should work even positively in us. For, we know that, when we first learn any of these things, we look industriously for such a Gender, or Number, or Case, or Tense, for such a Foot or Quantity, such a Note or Consonance; and we are sure, that use and practise of the same thing doth not change, but only facilitate the work: therefore it follows of necessity, that we still use those very instructions; by which at first we could but slowly creep, but now manage them with such celerity, as our fancy cannot keep pace with what we do. And this is the reason why we do not perceive that we think of them, but may peradventure at the same time think of a quite different matter: as, when a Musitian plays voluntary Division upon a ground he never saw before, and yet hath all the while some other thought in his head; or when a Painter draws a Picture, and all the while discourses with a by-stander.

This truth may be convinced by another argument: as, thus, It cannot be doubted, but that a Verse or Song is made by the power of making such compositions: but that power is the Art of them; and that Art is nothing else but the Rules wherby they are made.



made. And accordingly we see, that who hath not the art, cannot make such compositions, but who hath can, when he pleases; and if any man would be able to make them, he presently studies the art: so that it cannot be doubted, but that artificial things are always made by the use of those rules which teach the making of them; although, for the most part, we are not able to perceive how such rules are used. And besides this, we are sure, that we do not only make use of those rules we learnt at first; but, when we are arrived to Mastery in any Art, we make use of them in a quite different manner than we did in the beginning, and than we do in any other thing, wherein we find pain and difficulty.

In the second effect that we experience of our Understanding, (which is, our Casting-about for new conceptions, when those it already hath, appear not sufficient to direct what it has in hand) the force and working of it is very evident: for, this effect proceeds out of a want of satisfaction; and this belongs properly to the Understanding. For, if evidence and satisfaction be qualities of it, then of necessity the privation of these qualities must likewise belong to it; as also to discern that privation, and to use means to avoid it: and in the very casting-about, we see a choise made, and that things are not taken promiscuously as they come of a row, but that some of them are set aside and others advanced for use; which argues plainly the knowledg and government of the Understanding.

But, the third operation is that which gives clearest evidence, of the peculiar and distinct working of the Understanding. For, if we mark the contestation and strife within us, between our Sensual part, and its antagonist which maintains the resolution set by reason; and observe how exceedingly their courses and proceedings differ from one another: we shall more plainly discern the nature, and power, and efficacy of both of them. We may perceive that the motions against Reason rise up turbulently, as it were in billows; and like a hill of boiling water, (as truly Passion is a conglobation of spirits) put us into an unquiet and distemper'd heat and confusion. On the other side, Reason endeavours to keep us in our due temper; by sometimes commanding down this growing sea, otherwhile contenting in some measure the desires of it, and so diverting another

way.

45.  
How the Understanding casts about, when it wants sufficient grounds for action.

51.  
How Reason rules over Sense and Passion.



way its unruly force : sometimes she terrifies it, by the proposal of offensive things joyn'd to those 'tis so earnest to enjoy ; again, sometimes she prevents it, by cutting off all the causes and helps that promote on its impotent desires, and by engaging before hand the power of it in other things, and the like.

All which evidently convince, that, as Reason hath a great strength and power in opposition of Sense, so it must be a quite different thing and of a contrary nature to it. We may add, that the work of Reason can never be well perform'd, but in a great quiet and tranquillity ; whereas the motions of Passion are always accompanied with disorder and perturbation. So as it appears manifestly, that the force of Reason is not purely the force of its Instruments ; but the force of its instruments as they are guided, and as the quantities of them are proportioned by it. And this force of Reason, is different from the force of its instruments of themselves ; as the force of a Song is different from the force of the same sounds wherof it is composed, taken without that Order which the Musitian puts in them : for otherwise, the more spirits that are rais'd by any thought (which Spirits are the Instruments whereby Reason performs all her operations in us) the more strongly reason should work ; the contrary of which is evident, for we see that too great abundance of Spirits confounds Reason.

6.  
How we recal  
our thoughts  
from distracti-  
ons.

This is as much as at present I intend to insist upon, for proof that our Understanding hath its proper and distinct operations, and works in a peculiar manner, and in a quite different strain from all that is done by our Senses. Peradventure some may conceive that the watchfulness and recalling of our thoughts back to their enjoyn'd work, (when they break loose and run astray) and our not letting them range abroad at random, doth also convince this assertion : but I confess ingenuously, the testimony of it seems not clear to me ; and therefore I rank it not with those, that I would have (if it may be) solidly weighty, and undeniable to one who shall consider maturely the bottom and full efficaciousness of them. Of such, a few, or any one, is enough to settle ones mind in the belief of a truth : and I hope, that this which I have labour'd for in this Chapter is so sufficiently proved, as we need not make up our evidence with number of Testimonies.

But



But, to shew the exceptions I take against this argument, let us examine how this act within us, which we call watchfulness, is perform'd. Truly, me-thinks it appears to be nothing else, but the promptitude and recourse of some spirits, that are proper for this effect; which, by a mans earnestness in his resolution, take a strong impression, and so are still ready to knock frequently at the door of our understanding, and thereby enable it with power to recal our stray'd thoughts. Nay, the very reflection itself, which we make upon our thoughts, seems to me only this, that the object, beating upon the fanſie, carries back with it, at its retiring from thence, some little particle or atome of the brain, or *Septum Lucidum*, against which it beats, sticking upon it: in like manner as, upon another occasion, we instanced in a Ball rebounding from a green Mud-wall, to which some of the matter of the wall must needs adhere. Now, this object, together with the addition it gets by its stroak upon the fanſie, rebounding thence, and having no more to do there at present, betakes it self to rest quietly in some Cell it is disposed into, in the brain; as we have deliver'd at large in our former Treatise, where we discoursed of Memory: but whenever it is called for again by the fanſie, or upon any other occasion returns thither it comes as it were capped with this additional piece it acquir'd formerly in the fanſie; and so makes a representation of its own having been formerly there.

Yet, be these actions perform'd how they will, it cannot be deny'd, but both of them are such as are not fit, nor would be any ways useful to creatures, that have not the power of ordering their own thoughts and fanſies; but are govern'd throughout meerly by an uniform course of nature. Which ordering of thoughts, being an operation feasible only by rational creatures and none others; these two actions (which would be in vain, where such ordering is not used) seem to be specially ordain'd by nature, for the service of Reason, and of the Understanding: although peradventure a precise proper working of the understanding, do not clearly shine in it. Much less can we by experience find, among all the actions we have hitherto spoken of, that our Reason or Understanding works singly and alone by it self, without the assistance and consortship of the



the fanſie : and as little can I tell how to go about to ſeek any experience of it.

7.  
How Reason is  
ſometimes  
overcome by  
Senſe and Paſ-  
ſion,

But, what Reason may do in this particular, we ſhall hereafter enquire ; and end this Chapter with collecting out of what is ſaid, how it fares with us, when we do any thing againſt Reason, or againſt our own knowledge. If this happen by ſurprize, 'tis plain that the watch of Reason was not ſo ſtrong as it ſhould have been, to prevent the admittance or continuance of thoſe thoughts which work that tranſgreſſion. Again, if it be occaſion'd by Paſſion, 'tis evident that, in this caſe, the multitude and violence of thoſe ſpirits which Paſſion ſends boyling up to the fanſie is ſo great, as the other ſpirits, which are in the jurifdiction and government of Reason, are not able for the preſent to ballence them, and ſtay their impetuofity, whiles ſhe makes truth appear. Sometimes we may obſerve, that Reason hath warning enough to muſter together all her forces ; to encounter, as it were in battail, the aſſault of ſome concupiſcence, that ſends his unruly bands to take poſſeſſion of the fanſie, and conſtrain it to ſerve their deſires, and by it to bring Reason to their bent. Now, if in this pitch'd field ſhe loſe the bridle, and be carried away againſt her own reſolutions, and forced like a captive to obey the others laws ; 'tis clear, that her ſtrength was not ſo great as the contrary factions.

The cauſe of which is evident, for, we know ſhe can do nothing, but by the aſſiſtance of the ſpirits which inhabit the brain : now then it follows that, if ſhe have not the command of thoſe ſpirits which flock thither, ſhe muſt of neceſſity be carried along by the ſtream of the greater and ſtronger multitude ( which, in our caſe is the throng of thoſe that are ſent up into the brain by the deſired object ) and they come thither ſo thick and ſo forcibly, that they diſplace the others which fought under Reasons Standard. Which if they do totally, and, excluding Reasons party, entirely poſſeſs the fanſie with their troops ( as in madneſs and extremity of ſudden *paſſion* it happens ), then muſt Reason wholly follow their ſway, without any ſtrugling at all againſt it : for, whatever beats on the fanſie occaſions her to work ; and therefore, when nothing beats there but the meſſengers of ſome ſenſual object, ſhe can make



make no resistance to what they impose. But, if it happen that these tumultuary ones be not the only spirits which beat there, but Reason hath likewise some under her jurisdiction, which keep possession for her, though they be too weak to turn the others out of doors; then 'tis true, she can still direct fairly how in that case a man should govern himself, but, when he comes to execute, he finds his sinews already possess'd, and swell'd with the contrary spirits: and they keeping out the smaller and weaker number, which reason has rank'd in order and would furnish those parts with, he is drawn, even against his judgment and reason, to obey their appetites and move himself in prosecution of what they propose; experimenting in himself what the Poet expresses in *Medea*, when she complain'd and bemoan'd her self in these words, *Video meliora proboque, Deteriora sequor*. And in this case, a man foresees his misery all the way he rous towards it, and leaps into the precipice with his eyes open. Which shews that the Army of thoughts on Reason's side should be increas'd in number, to have her strong enough to wage battle with the rebellious adversary: or else, that her adversary should be so much weakned, that she, though not grown stronger in her self, yet might, through the others enfeebling be able to make her party good; (and hence is the use of corporeal Mortifications, to subject our Passions to the command of Reason). Even as when we see that, when we are in health, our arms, and legs, and all our limbs obey our will, reaching what we command them, and carrying us whither we desire; because the spirits, which are sent into them from our brain, are strong enough to raise and move them, as they are directed: but, if our sinews be so steep'd in some cold and watry humour, that the spirits coming down find not means to swell and harden them; well we may wish and strive, but all in vain, for we shall not be able to make them perform their due functions. In like manner, if Reason send her emissaries into the arm, or leg, or other member, and no other spirits there strive against them; then that limb is moved and govern'd absolutely according to her directions: but if, at the same time, a greater multitude of others hinder Reasons servants from coming thither, or flocking into other sinews, carry that limb a contrary way; in vain, Reason strives to move them to her byas, for those obeying parts must observe the rules which the violent conqueror prescribes.



## C H A P. V.

*Containing proofs out of our Single Apprehensions, that our Soul is Incorporeal.*

I.  
The connection of the subsequent Chapters with the precedent.

**A**S in our First Treatise we dissected Nature, and shew'd how, out of the notion and first division of Quantity, arises that vast multiplicity of things, which, filling this world, falls under the consideration of our senses: so, in the beginning of this Second Treatise, we have search'd into those operations of a Man (attributed to his Soul), by which he is conceiv'd to excel all other living creatures; and there discover'd, that the admirable and unlimited variety of works, which is seen in mens writings and actions, doth all flow from the source of Single Apprehensions, and even from one bare notion of Being (which is the root and principle, from whence all others derive their origine, and into which all may be resolved; Works proceeding from Resolutions, they from Discourses, these being composed of Judgments, and Judgments of Single Apprehensions). This part we must now review; and enquire what we can find in mans operation, arguing the Quality of his Soul, whether it be corporeal or no. For, if these Single Apprehensions, and the processes compounded of them, may be perform'd by the Ordering of Rare and Dense parts (as the other works of nature are); then they will be corporeal, and of the same kind with those which we opened in the first Treatise: but, if we shall prove, that they cannot possibly be deduced from Multiplicity, and Order of Quantitative parts; then we may confidently resolve of our selves, that in the cause from which they flow there is a nature, wholly discrepant from that which resides among bodies and corporeal things.

This we shall here labour to do; and, to that end, we will begin our work with reflecting on what we have deliver'd of a *Single Apprehension*, in the First Chapter of this Second Treatise: whose nature we there first explicated in common, and thence proceeded to some particular apprehensions, and lastly, shew'd the extent they comprehended. These then must be the subject of our present speculation.

As



As for their nature, we may remember how we resolv'd three things: first, that, by apprehension, the very thing apprehended is by it self in our Soul: next, that the notion of Being is the first of all notions, and resumed in all others: and thirdly, that, what is added to the notion of Being is but respects to other things. Now then, let us consider what kind of Engines they must be, that may have the power to make things themselves to be in our Soul, if they were to be there materially. How shall the place, or the time pass'd, be removed and put in another place, and in another time? How shall the quantity of the Heavens, of the whole World, nay, of Bigness exceeding all that, by millions of proportional encreases, be shut up in the little circuit of Mans Brain? And, if we examine our selves strictly, we shall find nothing wanting; all is there. How shall the same thing be corporeally in two, nay, in two thousand places, at the same time? And yet, in so many is the Sun, when two thousand men think of it at once. We must then allow, that things are there immaterially: and consequently, that what receives them is immaterial; since every thing is received according to the measure and nature of what receives it.

But, I easily conceive, that the strangeness and incredibility of our position may counterballance the force of it: for, who can perswade himself, that the very thing he apprehends is in his mind? I acknowledg that, if its being there were to be understood corporeally, it were impossible: but on the other side, who shall consider, that he knows the thing which he rightly apprehends, that it works in him, and makes him work agreeable to its nature, and that all the properties and singularities of it may be display'd by what is in him, and are as it were unfolded in his mind; he can neither deny nor doubt, but that it is *there* in an admirable and spiritual manner. If you ask me, how this comes to pass; and, by what artifice, Bodies are thus spiritualized? I confesse I shall not be able to satisfie you; but must answer, that it is done, I know not how, by the power of the Soul. Shew me a Soul, and I will tell you, how it works: but, as we are sure there is a Soul, (that is to say, a Principle from whence these operations spring) though we cannot see it; so we may and do certainly know, that this mystery is as we say, though, because we understand not the true and compleat nature

2.

The inexistence of corporeal things in the Soul, by the power of apprehension, proves her to be immaterial.



nature of a Soul, we can as little express the manner, how it is done by a Soul. Yet, before we take our leave of this matter of Apprehensions, we will, in due place, endeavour to say something towards the clearing of this obscure point.

3.  
The notion of  
Being, which  
is innate in  
the Soul,  
proves the  
same.

Our second consideration upon the nature of Apprehension was, that our primary and main notion is of Being. This discovers some little glimpse of the nature of the Soul. For, 'tis manifest that she applies this notion, as well to no-parts, as to parts. Which we prov'd in the first Treatise; when we shew'd that we have a particular notion of Substance, distinct from the notion of Quantity; for, Quantity and Parts being the same, it follows that if there be a notion supposed by Quantity, (as in Substance there is) it must of necessity abstract from parts: and consequently, we may conclude, that the notion of Being, which is indifferently applyable either to Quantity or Substance, of its own nature wholly abstracts either from Parts, or no-Parts. I then infer, that, since this notion of Being is the very first and virgin notion our Soul is imbued with or capable of, and is the root of all other notions, and into which she resolves every other notion, (so as, when we have sifted and searfed the essence of any notion whatever, we can discover nothing deeper than this, or precedent to it); and that it agrees so completely with our Soul, as she seems to be nothing else but a capacity fitted to Being: it cannot be denied, but that our Soul must needs have a very near affinity and resemblance of nature with it. But 'tis evident, that Being hath not of it self any parts in it, nor of it self is capable of division: and therefore 'tis as evident, that the Soul, which is fram'd (as it were) by that patern and *Idea*, and fitted for Being, as for its End, must also of it self be void of parts and incapable of division. For, how can parts be fitted to an indivisible thing? And, how can two such different natures ever meet proportionably?

If it be objected, that the very notion of Being, from whence we estimate the nature of the Soul is accommodable to parts: as for example, we see that Substance is endew'd with Quantity. We answer, that even this corroborates our proof. For, since all the substances, which our senses are acquainted with, have parts and cannot be without parts, and yet nevertheless



less in our Soul, the notion of such substance is found without parts; 'tis clear, that such substance hath this meerly from our Soul: and, because it hath this indivisibility from our Soul, it follows that our Soul hath a power and nature to bestow indivisibility upon what comes into her. And since it cannot be deny'd, but that, if any substance were once existent without parts, it could never after have parts; 'tis evident that the nature of the Soul is incapable of parts, because it is existent without parts. And, that it is in such sort existent is clear; for, this effect, of the Souls giving indivisibility to what she receives into her, proceeds from her, as she is existent: Now, since this notion of Being is of all others the first and Original notion that is in the Soul, it must needs, above all others, favour most of the proper and genuine nature of the Soul; in and by which it is, what it is, and hath its indivisibility.

If then it be press'd, how can Substance (in reality or in things) be accommodated to Quantity, since of it self it is indivisible? We answer, that such Substance, as is the subject of and hath Quantity, is not indivisible; for, such Substance cannot be subsistent without Quantity: and, when we frame a notion of it, as indivisible, 'tis an effect of the force of our Soul, that is, able to draw a notion out of a thing that hath parts, without drawing the notion of the parts. Which shews manifestly, that in her there is a power above having of parts: and this vertue in her, argues her existence to be such.

Our last consideration upon the nature of Apprehension was, how all that is added to the notion of Being is nothing else but respects of one thing to another; and how, by these respects, all the things of the world come to be in our Soul. The evidence we may draw from hence of our Souls immateriality will be not a whit less, than either of the two former. For, let us cast our looks over all that comes into our senses, & see if, from one end to another, we can meet with such a thing as we call a respect: it hath neither figure, nor colour, nor smell, nor motion, nor taste, nor touch: it hath no similitude to be drawn from by means of our senses. To be like, to be half, or be cause, or effect, what is it? The things (indeed) that are so have their resemblances and pictures; but which way should a Painter go about to

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draw

4.  
The same is  
proved by the  
notion of re-  
spects



draw a likeness, or to paint a half, or a cause, or an effect? If we have any understanding, we cannot chuse but understand, that these notions are extremely different, from whatever comes in to us by the mediation of our senses: and then if we reflect, how the whole negotiation of our understanding is in & by respects; must it not follow necessarily, that our Soul is of an extreme different nature from our Senses and Imagination? Nay, If we look well into this argument, we shall see, that, whereas *Aristotle* pretends, that *Nihil est in intellectu, quod non prius fuit in sensu*, this Maxime is so far from true, (in rigour of the words), that the quite contrary follows undeniably out of it; to wit, that *Nihil est in intellectu, quod fuit prius in sensu*. Which I do not say to contradict *Aristotle* (for his words are true in the meaning he spoke them); but to shew, how things are so much changed by coming into the understanding, & into the Soul, that, although, on the one side, they be the very same things, yet, on the other side, there remains no likeness at all between them in themselves & as they are in the understanding: which is a most evident proof, (when the weight of it is duly consider'd) that the nature of our Soul is mainly different from the nature of all corporeal things that come into our sense.

5.  
That corporeal things are spiritualiz'd in the understanding, by means of the Souls working in and by respects.

6.  
That the abstracting of notions from all particular & individual accidents: proves the immateriality of the Soul.

By this which we now come from declaring, the admiration, how corporeal things can be in the Soul, and how they are spiritualiz'd by being there, will in part be taken away. For reflecting that all the notions of the Soul are nothing but the general notion of a Substance or thing joyn'd with some particular respect; if we consider, that the respects may be so order'd, that one respect may be included in another, we shall see, that there may be some one respect, which may include all those respects that explicate the nature of some one thing: & in this case, the general notion of a thing, coupled with this respect, will contain all whatever is in the thing; as for example, the notion of a *Knife*: that it is a thing to cut with, includes (as we have formerly declared) all that belongs to a Knife. And thus you see how the mystical phrase, of corporeal things being spiritualiz'd in the Soul, signifies no more, but that the similitudes, which are of them in the Soul are Respects.

Thus having collected, out of the nature of Apprehension in common, as much as we conceive needful in this place to prove our



our assertion; our next work must be, to try if we can do the like, by reflecting on particular apprehensions. We consider'd them of two sorts; calling one kind universal ones, and the other collective ones. In the universal ones, we took notice of two conditions; the abstraction, and the universality of them. Now truly, if we had no other evidence, but what will rise from the first of these, that alone would convince and carry the conclusion. For, though among corporeal things, the same may be now in one place, now in another, or sometimes have one figure, sometimes another, and still be the same thing (as for example, wax or water); yet, it is impossible to imagin any bodily thing whatever to be at any time without all kind of figure, or without any place at all, or indifferent to this or to that: and nevertheless, all things whatever, when they are universally apprehended by the Soul, have this condition *in her*; by reason of their abstraction there, which in themselves is impossible to them. When we say, water, fire, gold, silver, bread, &c. do we mean or express any determinate figure? If we do, none but that precise figure will serve or content us: but 'tis evident, that, of a hundred different ones, any and every one doth alike intirely satisfy us. When we call for Money, if we reflect upon our fancy, peradventure we shall find there a purse of Crowns: nevertheless, if our messenger brings us a purse of Pistols, we shall not except against it, as not being what we intended in our mind, because it is not that which was painted in our fancy. 'Tis therefore evident, that our meaning and our fancy were different: for otherwise, nothing would have satisfy'd us, but that which was in our fancy. Likewise, in the very word (which is the picture of our notion) we see an indifferency: for, no Dictionary will tell us, that this word Money doth not signify, as well Pistols as Crowns; and accordingly we see, that, if our meaning had been precisely of Crowns, we should have blamed our selves for not having named Crowns, and not him that brought us Pistols, when we spoke to him by the name of *Money*. 'Tis most clear therefore, that our understanding or meaning is not fix'd or determin'd to any one particular, but equally indifferent to all: and consequently, that it cannot be like any thing which enters by the Senses; and therefore not corporeal.

The second condition of Universal Apprehensions is their universality: which adds to their abstraction one admirable particularity

7.  
That the universality of abstracted notions proves the same.



cularity; and it is, that they abstract in such sort, as to express at the same time even the very thing they abstract from. How is it possible that the same thing can be, and not be, in the same notion? Yet, let a man consider what he means when he saith, every man hath two eyes; and he shall see that he expresses nothing, wherby any one man is distinguish'd from another, and yet the force of this word Every expresses that every man is distinguish'd from another: so that in truth, he expresses *particularity* it self in *common*. Now, let our smartest and ingeniouest adversary shew or imagine, if he can, how this may be done in a picture, or in a statue, or in any resemblance of a body or bodily thing: but if he cannot, let him acknowledg an eminent and singular propriety in the Soul, that is able to do it.

Let us reflect, that particularity in a body is a collection of divers qualities & circumstances; as that it is white, of such a figure, in such a place, in such a time, and an infinitude of such like conditions conglobated together: then if our Soul be a Body, the expression of the particularity of a Body in the Soul must be a participation in her of such a conglobation, or of such things conglobated. Now let us imagine, if we can, how such a participation should be in common; and should abstract from all colour, all place, and all those things of which the conglobation consists: and yet we see, that in the Soul this is done; and he who saith, Every man, doth not express any colour, place, or time, and nevertheless by saying so, he expresses that in every man there is a conglobation of colour, place, and time. For, it could not be Every one, unless there were such conglobations to make Every one, one: and, if any conglobation were expressed in this term Every one, it would not be Every one, but only one alone. Now, if any coordination of parts can unfold and lay open this riddle, I wil renounce all Philosophy & Understanding.

8.  
That Collective Apprehensions prove the same.

Collective Apprehensions will afford us no meaner testimony than the other two, for the spirituality of our Soul. For, though it may seem to us, before we reflect thoroughly on the matter, that we see, or otherwise discern by our sense, the Numbers of things; as that the men in the next room are Three, that the Chairs there are Ten, and the like of other things: yet, after due consideration, we shall find, that our eye or sense tells us but singly of each one, that it is One; and so runs over every one of them, keeping them still each by themselves, under their own several unities.



unities : but then the Understanding comes, and joyns under one notion what the Sense kept asunder, in so many several ones as there are things. The notion of three or ten is not in the things, but in our mind; for why three rather, than five, or ten rather, than twelve, if the matter of which we speak were not determined? and such determination of the matter is an effect of the Understanding. If I had spoken of things, as I did of men or chairs, there had been more, than three or ten : it is then evident, that what determined my speech made the number be three or ten.

Again, we see that the notion of ten is but one notion; or as the name of ten is but one sign, so it argues that there is but one notion, by which it is the sign of ten things. Besides, we see that Arithmeticians find out the proprieties and particular nature of any determinate number : and therefore we may conclude, that every number hath a definition and peculiar nature of its own, as it is a Number. If then this definition, or nature, or notion of ten be a corporeal one, it is a corporeal similitude of the object. But, it is like to any one of the things, or to all the ten? If to any one, then that one will be ten; if it be like to the whole made of ten, then that whole being but one, ten will be just one, and not ten things.

Besides, to be ten expressly implys to be not one : how then can that be a material thing, which, by being one, represents many; seeing that, in material things, one, and many are opposite, and exclude one another from the same subject? And yet, this notion could not represent many together, but by being one.

Again, if it be a material notion or similitude, it is either in an indivisible of the brain, or in a divisible part of it : I mean, that the whole essence of the notion be in every part never so little of the brain, or that one part of the essence be in one part of the brain, and another in another part of it. If you say, that the whole essence is in every part of the brain, though never so little; you make it impossible to be a body: for you put the likeness of ten determinate bodies, in an indivisible manner; seeing that what by division grows not less hath the nature of an indivisible. But if you say, that divers parts of the essence are in divers parts



of the brain; then you make it impossible the notion of ten should be indivisible, since it self is composed of several parts.

In a word, ten things cannot be represented materially, but by ten other things: and there it is most evident, that the Soul, which represents ten by one thing or notion, doth not represent the ten materially: and consequently, that her self is immaterial.

What we have now said, will be confirmed by considering the terms, All and whole: for 'tis clear, that these terms also are of the nature of numbers; but withal express particularly that no part is wanting. If then the notion of All or whole be said to be material or quantitative, it must be divisible: but, if you divide it, no part remains, All or whole: it is not therefore divisible; nor consequently material. And, as this argument is manifestly applicable to numbers; so, if we look into the arguments concerning numbers, you will find all them likewise apply able to these terms, All and whole.

9.  
The operations of the Soul, drawing always from multitude to unity, prove the same.

Out of what hath been hitherto discover'd, we may gather this note, that it is the nature of the Soul, to draw from divisibility to indivisibility, from multitude to unity, from indeterminateness and confusion to a clarity & determination: as appears evidently in this last example of Collections; in which, whether we take numbers or other collective terms we see that throughout their natures consist in such a perfect indivisibility, as no part can be separated without destroying the essence of the notion. Nay, things which in themselves are many and consist in parts, in the mind get an impartible nature: for ten is no longer ten, if it be divided; nor all is all, if any thing be taken away. In the same manner, though Philosophy teach us, there be neither Points in Bigness, nor Instants in Motion or Time, yet Nature makes us express all Bigness by Points, and all Time by Instants: the Soul ever fixing it self upon indivisibility.

And this is the reason, why we attribute the nature of Substance to all our notions. If we see a thing white, or black, or do, or suffer, or be in a place, or in time, presently, in our apprehensions, we conceive these modifications of the thing, like substances: & accordingly we call them by Substantive names, Whiteness,



Whiteness, Action, Ubication, Duration, &c. Now, the reason of this is, because a Substance (that is, a thing subsisting of and determined within it self) is a fit and steady ground for the Soul to fix it self on: whereas these other Appendixes of Substance would not afford her easie footing to build her structures on, if she consider'd them as truly they are in themselves; and therefore, in her notion, she gives them the qualities of Substance. But withal it happens many times, that, by her doing thus, if she be not very wary, she is deceiv'd and falls into gross errors.

One thing more we must remember to take notice of: and it is, that, if we wil compare the notions in our Understanding, with the signs, which beating in our Fancies, beget those notions; we shall find, that these are but barely signs, and do not in their own nature express either the notions they raise, or the things they are signs of. This is evident in the images of the sounds we call Words: for 'tis clear, they have no likeness either with the things they signifie, or with the thoughts they beget in us. And we shall find it no less true of other images; for example, the exterior impressions of *sensible qualities*, which seem by themselves to be in the understanding: for, if we consider the matter well, we shall perceive that we understand nothing more by them, than we do by meer Words; and that, to work or discourse out of them, we must seek into the objects and their definitions, wherof we learn nothing by those first impressions. For, it seems that (for example) hot, or red, or sweet, to a man that first sees, or feels, or tastes them, signifies nothing else, but a thing which makes such an apprehension in his Soul, or such a phantasm in his interior sense: and nevertheless, as yet the man perhaps knows not that he hath a soul or an interior sense, nor reflects so far as to consider, that this motion passes by his exterior sense; but his apprehension is immediately carried to the thing without him, and he imagines that the impression he feels is the thing he feels. And so he that should feel himself heated by a burning glass, & were not acquainted with the vertue of such a glass, would think the glass were hot: yet certainly, his first apprehension is of the motion made in his fancy, (though he imagines it elsewhere), which impression he conceives to be the nature of the thing that makes it. And thus we see, that the conversion of the Soul is immediately

10.  
The difference  
betwixt the  
notion of a  
thing in our  
Understand-  
ing. and the  
impression that  
corresponds  
to the same  
thing in our  
Fancies, proves  
the same.



ly to a thing without the man : which also is the effect of her being fixed to Existence; for by reason of that she still apprehends every impression, as a thing.

But now, whether her apprehension includes the very impression, which is in the sense or in the fanſie, ſo that by its own likenefs it be in the Soul; or whether the Impreſſion in the fanſie makes a change in the Soul, which we cannot diſcern in it ſelf, but conceive it to be the impreſſion which is in the fanſie, becauſe that impreſſion is at the firſt continually preſent at the ſaid mutation : is more obſcure and hard to diſcover. But when we reflect that, after ſome time, words ſucceed in lieu of this impreſſion, and perform the ſame effect as the original impreſſion; in what language ſoever they be utter'd, ſo they be underſtood : we may conclude out of this evident ſign, that the impreſſion is in the underſtanding, not in its own likenefs, but in another ſhape, which we do not diſcover; and which is excited, as well by the name, as by the impreſſion, in a man that is uſed to the names.

Again, in a man that learns things by himſelf, theſe impreſſions ſerve for words, and not for things : for, ſuch a man never looks into his fanſie to diſcourſe on any thing, but only upon the mutation he conceivs is made in the extern ſenſe; out of which he gathers by little and little the nature of the thing, whoſe notion was made at firſt in him by this impreſſion. Whence is manifeſt, that our knowledg is a different thing from the Phantaſmes which beat at the Souls door, as the thing ſignifi'd is from the ſound of the word, or as the Wine in the Cellar is from the Buſh : and therefore, 'tis impoſſible that the Soul (in which that knowledg reſides, and which indeed is that knowledg) ſhould be a corporeal thing; ſince, of all bodily things, the motions that are made by the ſenſible qualities arrive neareſt to a ſpiritual nature.

II.  
The apprehenſion of negations and privations prove the ſame

It remains now, that we ſhould argue for the immateriality of the Soul, out of the *extent* of our apprehenſion, which ſeems to be ſo exceſſive, as not to be comprehenſible by the limitations of bodies; & therefore cannot belong to a body: but, becauſe all that needs to be ſaid in this particular follows plainly out of grounds already urged, & that this point contains not any notable particularity deſerving mention here; we will not enlarge



large our selves any further upon it, but pass on to the next line of operations proper to our mind.

Only we may not omit taking notice of the expressions which our mind makes of Nothing, or as Logicians term it, of Negations and Privations : which argue an admirable power in the Soul, and of a quite different strain from all corporeal things ; and evidently convince the immateriality of it. For, it cannot be doubted, but that the Soul knows what she means, when she discourses of Nothing. Now, if all her knowledge were nothing else but corporeal phantasms, or pictures made by corporeal things ; how should she come to have a notion of Nothing ? for, since it is most clear, that something cannot be like Nothing ; and that there cannot be a participation of what is not : how can we conceive that there should be a similitude made of Nothing ?

The way therefore that the Soul takes in this operation is, that, comparing two things together, and finding that the one of them is not the other, she reflects upon her own action ; and dividing in it the *thing said*, from the *saying*, she takes the thing said for a Quality, or Property, or Predicate (as Logicians call it) of that thing which she denies to be the other thing : and then she gives it a positive name ; after she hath first made a positive notion, to which the name may agree. As for example, when the Soul considers a man that hath not the power to see ; as soon as she hath to her self pronounced, that he hath not such a power, she takes the not power to see for a quality of that man, and then gives the name of blindness to that not power of seeing : which, though of it self it be nothing, yet by being that which satisfies her act, when she saies that he hath not the power of seeing, it seems to be ranked among those things to which names are due ; for it hath a notion, and the having a notion is the claim, or merit, or dignity, in virtue whereof things are preferred to names.

Now then, let us enquire, how the power of Rarity and Density, or the Multiplication and Order of Parts, can be raised and refined to the state of being like nothing, or the similitude of a negation ; or what Operation of Rarity or Density can forge out this notion of blindness, which we have explicated : and when we find it beyond their reach to compass, we must acknowledge,



Iedg that the Soul is another kind of engine, than all those which are in the store-house of Bodies.

## CHAP. VI.

*Containing proofs out of our Soul's operations in knowing or deeming any thing, that she is of a spiritual nature.*

E.  
The manner  
of judging or  
deeming, by  
apprehending  
two things to  
be identified,  
proves the  
Soul to be im-  
material.

Our next consideration shall be, to see what testimony our manner of Judging yields us of the nature of the Soul: concerning which, three things offer themselves, worthy the reflecting on; which are, our Manner of Thinking, the Opposition which frequently occurs in our Thoughts, and the Nature of Truth and of Falshood. As for the first, we may remember how we have shew'd, that all judgment or deeming is but an apprehension of identification, or something immediately following out of it; and that a settled judgment or assent of the mind, is, as it were, a limb, or branch, or graft in our Soul: so that, we find our perceiving of identification between two things, or our seeing that the one is the other, is that by which our Soul encreases. Now, because, when two things are identified, the one reaches not further than the other; 'tis clear that this encrease of the Soul is not made by parts, which, being added one to another, cause it to be greater: and therefore, since this course is the only means of increase in bodies and quantity, 'tis clear that the nature of the Soul is quite different from the nature of all corporeal or Quantitative things.

Again, 'tis against the nature of identification, to be of parts; and therefore, they who take quantity to be one thing, and not many things tied together, acknowledg that truly there are no parts in it: And this is so rigorously true, that, although we speak of two things that in reality are identify'd one with another; yet, if our words be such, as imply that our understanding considers them as distinct parts, and by abstraction gives them the nature of parts, then they are no longer identify'd, but, in good Logick, we ought in this case to deny the one of the other. As for example: though the hand and the foot be the same thing, (as we have declared in our first Treatise); yet because, in the name



name Hand, there is a secret exclusion of any thing that is not in the definition of a hand, it follows that in our speech we must say, that a hand is not a foot. Likewise though it be confessed, that the Thing which is rationality is also risibility; nevertheless, it is a solecism in Logick, to say, that rationality is risibility: because it is the nature of these abstracted names, to confine their significations to one definition, and the definitions of these two terms are diverse. Out of this consideration it follows clearly, that, seeing the nature of parts is contrary to the nature of identity; and that the Soul in her judgments works altogether by identity: 'tis impossible that her operations should consist of parts, or in any sort resemble any proceeding of Quantitative things.

The like will be convinced out of the Oppositions we find in our thoughts. In it we may consider two things: first the generation of it: next, the impossibility of Opposites in the Soul. To begin with the first. We see that, in speaking, opposition is produced by the addition of this word Not: as when we say, not a man, not a peny, not a word: and therefore it follows, that in our Soul there is a notion of it, correspondent to the word that expresses it. Now, seeing that a notion is a thing, and that it is the likeness of its object, or rather the same with the object; let us cast about, how we should, of parts and of quantity, make a nothing, or an identification to Not: and when we find, that it is ridiculous and absurd to go about it, let us conclude, that the manner of working, which our Soul uses, is far different from that which is used in bodies, and among material things.

And if you object, that, not only a body, but even any other substance whatever (suppose it as spiritual as you will) cannot be either like or identified to nothing; and therefore this argument will as well prove that the Soul is not a thing or substance, as that it is not a body: We answer, that it is evident, out of what we have already said, that the Understanding is not the Objects it understands, by way of Similitude, but by a higher means; which we have shew'd to be by way of Respects. Now then, the respect which the thing hath to another thing, by not having such a respect to it, as a third thing formerly consider'd hath thereto, may be express'd in way of Respects, though it cannot in way of Similitude, and so our understanding is able to express, what

2.  
The same is proved by the manner of apprehending Opposition in a negative judgment.



what neither our fanſie nor any corporeal thing can arrive to the expreſſion of. As when firſt we find that one man hath a reſpect to the wall, which we call the power of *ſeeing*; if afterwards we find that another man hath a reſpect to the wall, of impotence that he *cannot ſee* it: this ſecond reſpect the underſtanding hath a power to expreſs, as well as the firſt; as we have touch'd above.

3.  
That things  
in themſelves  
opposite to one  
another hav-  
ing no oppo-  
ſition in the  
Soul, doth  
prove the  
ſame.

As for the oppoſition that occurs in our thoughts, we may conſider it of two kinds. The one is of the things or objects that come into our thoughts or Soul; and this is not properly an oppoſition in the Soul: For, though the things be oppoſite by their own nature in themſelves, yet they do not exerciſe their oppoſition in the Soul. Nay, though the oppoſition be even in the Soul it ſelf, if the Soul with this oppoſition be conſider'd as an object, it makes no oppoſition in her: for ſo you may conſider your Soul learned and unlearned, ignorant and knowing, good and bad, and the like; all which are oppoſitions in a Soul ſuppoſed to be ſo qualified, but none in a Soul that conſiders them. No more than fire and water, heavy things and light, white and black, being and not being, an affirmative propoſition and its negative, and the like; all which are in themſelves ſo contrary and oppoſite to one another, that they cannot conſiſt together in one ſubject: they have an impoſſibility among themſelves, wherever the one of them is, by its very entrance it drives out its oppoſite; and yet in the Soul they agree together without reluctance, ſhe knows and conſiders and weighs both ſides of the ſcale at the ſame time, and ballances them evenly one againſt another. For, unleſs both the oppoſites were in the ſame inſtant in the ſame comparing power, that power could not by one act, whoſe beginning implies its ending, judg the difference and oppoſition of them: as when we ſay black is contrary to white, or darkneſs is the want of light, we pronounce one common Not being of both extremes.

We may then boldly conclude, that, ſince no body whatever can entertain, at the ſame time, and in the ſame place, theſe quarrelling Antagoniſts; but that, by their conflict, they preſently deſtroy one another, and peradventure the body too, into which they preſſe for entrance, and the entire poſſeſſion of which each of them ſtrives for, ( thoſe of them I mean, that are propor-  
tion'd



tion'd to the reception of bodies): and that the Soul imbibes them together without any difficulty or contract, and preserves them always friends even in the face of one another, & lodges them together in the same bed: and that (in a word) these opposite things enjoy an admirable and unknown manner of Being in the Soul, which hath no parallel in bodily things: we may (I say) boldly conclude, that the Soul it self in which all these are, is of a nature, and hath a manner of Being, altogether unlike the nature of bodies, and their manner of Being.

Out of this agreeing of all Objects in the Soul & their having no opposition there, even whiles she knows the opposition that is between them in themselves, there follows another consideration, of no less importance: which is that the amplitude of our Soul, in respect of knowledg, is absolutely infinite: that is to say, she is capable of knowing, at the same time, objects without end or measure. For the explicating wherof, we are to consider, that the latter conclusions, which the Soul gains knowledg of, hang to the former by identification, or by the Soul's seeing that two notions are identified, because they are identified to a third; as is before expressed: & the first principles which seem to be immediately joyn'd to the Soul, have the identity of their terms plain and evident, even in the very terms themselves. Nay, if we insist further, we shall find that the First Truths must have an identification to the very Soul it self. For it being evident, that Truth or Falshood is not in the Soul, but so far forth as she applies her self to the external object, or to the existence of things in themselves; and that we find that the Souls knowing with evidence that any thing is or *hath being*, implies her knowing that her self is (for she cannot know that a thing seems so to her, or makes such an impression in her, without knowing that her self is; though peradventure she may not know what her self is, but takes her self to be no other thing, than the body of the man in which she is): 'tis evident that the First Truths which enter into the Soul, to wit, that this or that seems so or so to her, (and these truths no Scepticks ever doubted of), are identify'd with the Soul it self; since an object

4  
That the First  
Truths are  
Identified to  
the Soul.



object seeming to be such or such, is nothing else but the Soul is so qualified.

And in this we find, that the certainty of the first Principles, as for example, of this Proposition, *That* the whole is bigger than the Part, will depend, in a particular Soul, of her certainty of her own Being. For, though this Proposition would have a necessity in the very connexion of the terms, notwithstanding there were not in nature any Whole or Part; yet this necessity would not be a necessity of Existence or Being in the object, but a necessity of connexion, as it were, of two parts of the Soul: and so, if Verity and Fallity be not perfectly in the Soul, but in the comparison to actual existence, the Soul would not be perfectly true, or (to say more properly) would not have the perfection of truth in her, by having or knowing this Proposition, unless withal she were certain, that there were existent an object of this Proposition; of which (as we have said) she cannot be certain, without being certain of her own Being. So that, in effect, the identification of other things among themselves, by which such things are known, comes at last to be retrived in the existence of the Soul it self; and to be in the Soul, by the identification of those other things to her self.

5.  
That the Soul  
hath an infi-  
nite capacity,  
and conse-  
quently is im-  
material.

Now then, to proceed to the proof of our proposed conclusion; 'tis clear, that the adding of one thing to another doth, out of the force of this addition, perfect the thing to which the addition is made, if the advenient thing be added in such way as the former is apt to receive it: but 'tis evident, that the Soul is made fit by former Propositions, to be identify'd to later; for we see that the former ones draw on, and infer the later: therefore it follows, that, the more is added to the Soul, the greater is her aptitude to have more, or to be more encreased; and consequently, that the more is added to her, the more may still be added, and the more capable and more earnest she is to have more. Wherefore it cannot be deny'd, but that, since in the nature of the objects there is no impediment to hinder their being together in the Soul, (as we have proved a little above); and that in her, by receiving new objects, there is a continual encrease of capacity to receive more; she hath an amplitude to knowledg absolutely



absolutely infinite, in such a manner as we have above expressed.

Now, to apply to our purpose what we have gather'd by this discourse: 'tis clear, that these two conditions, of one thing not driving out another, and infinity of accessions, openly disclaim from Quantity, and matter; (for, we see that what hath Quantity, or is a Body, cannot admit a new thing into it, unless some other thing first go out, to make room for the adventitious one; and as for infinitude, it breeds a Sea of contradictions, if it be but thought of in Quantity); and therefore we may conclude, that the Soul, to whom these two conditions belong, is not quantitative or corporeal, but immaterial and of a spiritual nature.

The second kind of opposition that occurs in our thoughts or Soul, is of Contradictory Propositions. It hath its origine in the opposition of Being to not-Being; and is when a thing is identify'd to the Soul, in such sort as we have said, that a Judgment or Deeming makes the object become, as it were, a limb or part of the Soul. And, because the conflict of two such Propositions, if they were together in the Soul, would make her be something contrary to the nature of Being (if any thing can be contrary to Being) which in the Schools they call *ens & non ens*; the impossibility of her admitting into her self two such Propositions together, testifies her firm cleaving and fixedness to Being: and so confirms and brings new evidence to that argument for the Souls spirituality, which, in the first Chapter of this part, we drew from the nature of Being.

As for Truth and Falshood, they spring from the same root as the last; as being qualities consequent to the opposition of affirmative and negative Propositions, wherof if the one be true, the other must necessarily be false: and therefore, we need not spend time in setting down any particular considerations of these, since what we have said of the other is applyable to them; but 'tis sufficient, that we thus note them, to give the Reader occasion to reflect on them.

Among Propositions, there are some which Logicians term of eternal Truth: and, out of these, there are ingenious men, who imagine that the immortality of the Soul may be immediately deduced. Herein they rove not quite from the mark; though

6.  
That the opposition of contradictory Propositions in the Soul proves her immaterial.

7.  
How Propositions of eternal Truth prove the immateriality of the Soul.



withall I must needs say, they do not directly hit it. To understand the utmost that may be infer'd out of such Propositions, we may note two conditions in them : the first is, that generally these Propositions are universal ones ; and therby have that force to convince the spirituality of the Soul, which we have explicated and shew'd to belong to universal terms: the second is, that in these Propositions, there is a necessity of connexion between their terms ; such an one, or at least very like thereto, as we explicated in those Propositions, which bear their evidence plain in their very terms. And, out of this we may draw another argument for the spirituality of the Soul. For, we see that all corporeal agents and patients are defectible and contingent, that is to say, sometimes, or (if you will) most times, they attain their effect, but withall, sometimes (be it never so seldom) they miss of it ; and accordingly it happens sometimes that our eyes, our ears, our touch, and the rest of our senses are deceiv'd, though, for the most part, they give us true information of what they converse with : But, these Propositions of *eternal verity* never fail ; they have in themselves an indefectibility insuperable : And consequently, they give evidence, that the Souls nature is of a higher degree of constancy and certainty, than what falls within the compass of Bodies, and is of a nobler and different strain from all corporeal things ; for, this certainty is entail'd upon such Propositions by the force of Being, which is the proper object of the Soul, and they have their Being as limbs and parts of the Soul.

As for the term of *Eternal verity*, it is not to be taken positively ; as if these Propositions, or their objects, have any true eternity or perseverance, without beginning or ending : but only negatively ; that is, that there can be no time, in which they are false : and therefore, we cannot, out of their having such a kind of Eternity belonging to them, argue a capacity of infinite time or duration in our Soul that comprehends them.



## C H A P. VII.

*That our Discoursing proves our Soul to be incorporeal.*

**H**AVING thus run over those proofs, for the immateriality of our Soul, which arise out of her manner of working when she judges; in the next place we are to enquire, what others her manner of *Discoursing* will afford us. We are sure, that since our Discourse is composed of Judgments, and of single Apprehensions; it cannot choose but furnish us with all those Pregnant Arguments, that we drew from them. But, that will not serve our turn: we look after new Evidence: and we shall see it will give it us with full hands. It consists in this, that, when we Discourse, we may easily perceive there is more at one time in our Mind, than we can discover to be in our Fantasie. For, we find, that in our Fantasie, as one Proposition comes, another is gone: and though they that are gone seem to be ready at a call, yet they are not in presence; as being things which consist in motion, and that require place, and therefore the one jostles the other out of the place it possessed. But if it fared in like manner in our inward Soul, we could never attain to knowledg. For, 'tis manifest, that our Soul is not assured of a Conclusion, but by her seeing the Premises: if then the Premises be taken away, the Conclusion that rests upon them falls to the ground; but they are taken away; if they be out of our mind; therefore, when our understanding yields its assent to a Conclusion, it must of necessity have the Premises still in it.

But we must not rest here; this consideration will carry us on a wondrous deal farther. We know, that he who goes to frame a new demonstration in any Subject, must be certain he takes nothing contrary to what he hath learned in many Books; likewise, that he who will make a Latine Verse, or reads a Poem, knows there is nothing in all that Poem contrary to his Prosodia: do we not then manifestly perceive a certain remainder of all these in his Soul? The like is in all arts: in which he

F f f

that

That, in Discoursing, the Soul contains more in it at the same time than is in the fantasie; which proves her to be immaterial.



that goes about any work, according to art, shews he hath in his head all the rules of that art, though he do not distinctly remember or call them to mind, while he works. For, if he have them not, how doth he work by them? Since then 'tis clear, he thinks not of them at that time; 'tis as clear, that more is in the Soul at one time, than is in his Fantasie: or than can be there by material bodies (which, we have shew'd, is the way, wherby all things come into the Fantasie); though it be the nimblest and the subtilest Agent of all corporeal things whatever.

2.  
That the nature of Discourse proves the Soul to be order'd to infinite knowledge; and consequently to be immaterial.

Another consideration, wherby to evince the immateriality of the Soul, concerns the proceeding of Syllogisms by links, fast'ned to one another: whence we may take notice, that every one of them is a step to another: and consequently, 'tis manifest that, according to the nature of the Soul, they must be altogether in her; since, if any one were absent, all the rest that follow'd and depended upon that one, would have no grounding or fixedness in the Soul. Now, if to this we add, that what is to be known is absolutely and liquidly infinite, there cannot be brought or expected a more pregnant and home-witness of our Souls spirituality: it following out of these grounds that the Soul, by its nature, is, not only capable of, but expressly order'd to an infinite knowledge of infinite objects altogether. For, these two, finite & infinite science, are so vastly different from one another; that, if the same subject be capable of both, it must of necessity be order'd to infinite, as to its chiefest act and end. And thus, out of capacity in this subject, its being ordered is well infer'd, though in other matters peradventure the consequence may not be good. And accordingly, who looks into Geometry, Arithmetick, Logick, or even nature it self, will evidently see, that the objects of knowledge are every way, and in every Science, multipliable without end.

3.  
That the most natural objects of the Soul are immaterial; and consequently the Soul her self is such.

Neither ought this to be neglected, that a great part of the Souls objects, and indeed of those that are most natural to her, is above the capacity, and out of the reach of material things. All *Metaphysicks* abstract from quantity: the investigation of God, of Angels, of the Soul it self either concludes immateriality, or at least works about it.

What



What shall I say of Logical notions, those which are call'd the second intentions; about which there is so much business both in the Schools and in the World? 'Tis sufficient, that we have already express'd, how all our notions are respective. But, in particular, the motives of humane actions are very abstracted considerations: as for example, Hope of things to Come, Memory of things Past, Vertue, Vice, Honour, Shame, and the like. To these let us add, that, when we teach or explicate any thing to ignorant persons, we must frame our own apprehensions to their capacity, and speak such things as they may comprehend: which capacity or extent of comprehension we cannot see or perceive by any sense; but judge it meerly by our Reason and Understanding. Wherefore, since our operation is mainly and chiefly on and by such motives, as are not liable to material principles and compositions; it is evident, that the spring-head, from whence such operation flows, must also be immaterial and incorporeal.

I am not ignorant, that this Argument uses to be answer'd, by urging, that the Soul likewise knows Deafness, Dumbness, Blindness, and such other notions of Nothings; and yet is not from thence infer'd to be Nothing: it conceives *God* and *Eternity*; and yet it is neither from it self, as *God* is, nor eternal. In like manner (say they) it may know incorporeal things, and yet not be therefore it self incorporeal. To this I reply, first, wishing them not to mistake me, but to give my argument its full force and weight: for, there is a very great difference between the knowing of a thing, in a strained, toilsome, and confused manner; and the having a thing for its ordinary matter and subject of negotiation: this argues connaturality between the Soul and what it is so conversant about; but that doth not. Now, what is infer'd out of whole Sciences and Arts concerns a main stock of the Souls business; and not some extraordinary vertue or powers she hath.

But, to come up to close to the answer, I say, that if we, being thoroughly acquainted with material things, can find that it is not in the possibility of any such to be the likeness of an immaterial thing; and from thence infer, that our Soul, for being



fraught with immaterial notions, is not material; our conclusion is well collected and a very good one: for, the premises out, of which we gather it, are within our kenning; and therefore, if there were any defect in the consequence, we should easily perceive it. Whence it appears clearly, that there is no parity between the deduction of our conclusion, and that other which the objection urges, that our Soul, because it can know eternal things, is also eternal: for, Eternity is a thing beyond our comprehension; and therefore it ought not to be expected at our hands, that we should be able to give an account where the brack is and, to say the truth, if knowledg be trken properly, we do not know Eternity; however by supernatural helps we may come to know it: but in that case, the helps are likely to be proportionable to the effect. Neither are Negations properly known; seeing there is nothing to be known of them. And thus we see that these objections, proceed from the equivocation of the word *knowledg*; somtimes used properly, other-times apply'd abusively.

### CHAP. VIII.

*Containing proofs, out of our manner of proceeding to Action, that our Soul, is incorporeal.*

That the Souls  
being a power  
to order  
things proves  
it to be im-  
material.

**I** Doubt not but what we have already said hath sufficiently convinced our Souls, being immaterial, to whomsoever, is able to penetrate the force of the arguments we have brought for proof therof, and will take the pains to consider them duly; (which must be done, by serious and continued reflection, and not by cursory reading, or by interrupted attempts): yet, since we have still a whole field of proofs untouched, and, in so important a matter, no evidence can be too clear, nor any pains be accounted lost, that may redouble the light, although it shine already bright enough to discern what we seek, we will make up the concert of unanimous testimonies to this already establish'd truth, by adding those arguments we shall collect out of the maner of our Souls proceeding to action,



to the others we have drawn from our observations upon her Apprehensions, her Judgments, and her Discourses.

Looking then into this matter the first consideration we meet with, is, that our Understanding is, in her own nature, an orderer; & that her proper work is to rank & to put things in order. For, if we reflect on the works and arts of men, as, a good life, a common-wealth, an army, a house, a garden, all artefacts; what are they, but compositions of well order'd parts? And in every kind, we see that he is the Master, & the Architect, & is accounted the wisest, & to have the best understanding, who can best, or most, or further, than his fellows, set things in order. If then to this we joyn, that Quantity is a thing whose nature consists in a capacity of having parts and multitude; and consequently is the subject of ordering and ranking: doth it not evidently follow, that our Soul, compared to the whole mass of bodies, & to the very nature of corporeity or quantity, is as a proper agent to its proper matter to work on? Which if it be, it must necessarily be of a nobler strain, & of a different & higher nature than it; and consequently, cannot be a body, or be composed of Quantity: for, had matter in it self what it expects and requires from the agent, it would not need the agents help, but of it self were fit to be an Agent, Wherefore if the nature of corporeity, or of body, in its full latitude, be to be order'd, it follows that the thing whose nature is to be an orderer must, as such, be not a body, but of superiour nature, and exceeding a Body: which we express by calling it a spiritual thing.

Well then, if the Soul be an orderer, two things belong necessarily to her: one is, that she have this order within her self; the other, that she have power to communicate it to such things, as are to be order'd. The first she hath by Science; of which enough already hath been said towards proving our intent. Next, that her nature is communicative of this order, is evident out of her action and manner of working: But, whether of her self she be thus communicative, or by her conjunction to the Body she informs, appears not from thence. But, where experience falls short, Reason supplies; and shews us, that of her own nature she is communicative of order:

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for

2.  
That the Soul's being able to move without being moved proves her to be immaterial.



For since her action is an ordering, and in this line there are but two sorts of things in the world, namely, such as order, and such as are to be order'd; 'tis manifest: that the action must, by nature and in the universal consideration of it, begin from the orderer, (in whom order hath its life and Subsistence), and not from that which is to receive it; then, since ordering is motion, it follows evidently, that the Soul is a mover and beginner of motion.

But, since we may conceive two sorts of movers; the one when the agent is moved to move, the other, when of it self it begins the motion without being moved; we are to enquire, to which of these two the Soul belongs: But, to apprehend the question rightly, we will illustrate it by an example. Let us suppose that some action is fit to begin at ten of the clock. Now, we may imagine an agent to begin this action in two different manners, one, that the clock, striking ten, breeds or stirs somewhat in him, from whence this action follows: the other, that the agent may, of his own nature, have such an actual comprehension or decurrence of time within himself, as that, without receiving any warning from abroad, but as though he mov'd and order'd the clock, as well as his own instruments, he may of himself be fit and ready, just at that hour, to begin that action; not as if the clock told him, what hour it is, but as if he, by governing the clock, made that hour to be, as well as he causes the action to begin at that hour. In the first of these manners, the agent is moved to move; but in the second, he moves of himself, without being moved by any thing else. And in this second way, our Soul, of her own nature, communicates her self to quantitative things, and gives them motion: which follows out of what we have already proved, that a Soul, in her own nature, is the subject of an infinite knowledg, and therefore capable of having such a general comprehension, as well of time & the course of all other things, as of the particular action she is to do; and consequently stands not in need of a Monitor without her, to direct her when to begin:

If then it be an imprevaricable law with all bodies, that none whatever can move, unless it be moved by another:  
it



it follows, that the Soul, which moves without being stirr'd or excited by any thing elseis of a higher race, than they; and consequently, is immaterial and void of Quantity. But, let me not be mistaken in what I come from saying; as though my meaning were, that the Soul exercises this way of moving her self, and of ordering her actions, while she is in the Body: for, how can she? seeing she is never endew'd with compleat knowledg requisite for any action; never fully comprehending all the circumstances of it. But, what I intend is, that the nature of the Soul, consider'd in it self, is such, as hath a capacity and may reach to this manner of working, (whence I infer that she is not a Body but a Spirit); without determining, whether she work thus in the body, or out of it: that enquiry belongs not to this place; it will follow by and by.

But, for the present, having consider'd to what kind of working the nature of the Soul in abstract is capable of attaining; we will conclude this Chapter, with reflecting on those actions of hers, which fall daily under our remark, as being exercised in the Body. In all of them we may observe, that she proceeds with a certain Universality & indifferency; beyond the practice of all other creatures whatever. For example, if a man be spoken to, or ask'd of a hundred several things that he never thought of before in all his life; he will immediately shape pertinent replie's to all that is said, & return fitting answers to every question: As, *Whither such a man goes? How long this staff is? What colour that mans cloaths are of? &c.* To all which, & to as many things more as you will, (so they be within the compass of his knowledg) he straight answers differently, and to the purpose. Whence 'tis manifest, that his answers do not proceed upon set gimals or strings, wherof one being struck moves the rest in a set order, (which, we have shew'd, is the course in all actions done by Beasts); but, out of a principle within him, which of it self is indifferent to all things; and therefore can readily apply it self to the answer, according as by the question it is moved. And the like may be observ'd in his actions; which he varyes, according to the occasions presented.

5.  
That the Soul's  
proceeding to  
action with an  
Universality,  
& indifferen-  
cy proves the  
same.



I remember how Sir *Phillip Sidney* ( the Phoenix of the age he lived in, & the glory of our Nation; & the patern to posterity of a compleat, a Gallant & a perfect Gentleman) aptly calls our hands, *the Instruments of Instruments*; from *Aristotle* who terms them *Organa organorum*, or universal instruments, fitly moulded to be employ'd in any service. Nature hath, to all, other Creatures, appropriated their instruments to determinate actions; but to Man she hath (in these) given such, as might be apply'd to any kind of work whatever. And accordingly we see, that the same kind of Bird still builds her nest and breeds her young, in the same way, without any the least variation at all: but men build their Houses as they please, sometimes upon hills, sometimes in vales, sometimes under the earth, and sometimes upon the tops of trees; and the manners of breeding or instructing their Children are as divers, as the Customs of Nations and Towns. And, in all other actions, our Masters note it for a property peculiar to Man, that he uses to arrive to the same end by divers means; as, to transport our selves to some place we would go to, either by water, or by horse, or by coach, or by litter, as we please: whereas we see no such variety in like actions of other living creatures.

All which being so, we may conclude, that the Souls proceeding, either to answers or to action, argues clearly that she hath within her self such an indifferency, as is joyn'd with a means to determine this indifferency: the contrary whereof we see in all corporeal Engines; for, they have every step, in the whole course of their ways, chaulk'd out to them by their very framing, (as hath been amply declared in the first Treatise) and have the determination of the work, from end to end, set down and given them by their artificer and maker. And therefore 'tis most evident, that the Soul cannot be a thing composed or framed of material and quantitative parts; seeing she hath not her ways set down to her, but frames them of her self, according to the accidents that occur.

4.  
That the quiet  
proceeding of  
reason proves  
the same.

The same nature of the Soul discovers it self in the quiet proceeding of Reason, when it works with greatest strength and vigour; as well knowing, that its efficaciousness consists,  
not



not in the multitude of parts, which Passion breeds, but in the well ordering of those it already hath under its command : Whereas the strength of Quantity, and the encrease of its strength, consists in the multitude of its parts ; as will evidently appear to whom shall consider this point deeply.

Thus we have, in a summary manner, gone through all the Operations of the Soul ; which, in the beginning of this latter Treatise, we heap'd together, as Materials wherewith to raise an immaterial and spiritual building. Neither, I hope, will our Reader be offended with us, for being more succinct and concise in all our discourse concerning our Soul ; than where we deliver'd the doctrine of Bodies : for, the difficultness of this subject, and the nicety required to the expressing our conceptions concerning it, wherein (as the proverb is) a hair is to be cloven, would not allow us that liberty of ranging about, as when we treated of Bodies. What occurs among them may be illustrated by examples within our own orb, and of their own pitch : but, to display the operations of a Soul, we can find no instances able to reach them ; they would rather embroil and darken them. For, the exact propriety of words must be strictly and rigorously observ'd in them : and the Reader shall penetrate more into the nature and depth of them, by serious meditation and reflection upon the hints we have here given, (efficacious enough, I hope, to excite those thoughts he should have for this purpose, and to steer them the right way) ; than by much and voluminous reading, or hearing long and polish'd discourses, on this subject.

For my part, if what I have here said should to any man appear not sufficient, to convince that our Soul is of a spiritual and far different nature, from all such things as, in our First Treatise, we have discours'd on, and taken for the heads and most general kinds of Bodies, (to which all other particular ones and their motions may be reduced) : I shall become a suitor to him, to take This Subject into his handling, where it begins to be unwieldy for mine ; and to declare to us, upon the principles we have settled in the first Treatise, and upon considering the nature of a Body, ( which is the first of all our notions), how these particulars, we have reflected upon in

mans

5.  
A Conclusion  
of what hath  
been said hi-  
therto in this  
Second Treatise.



mans actions, can be drawn out of them. For, I can find no possible means to link them together : a vast and impenetrable Ocean lyes between the discoveries we have made on each side of its shores, which forbids all commerce between them, at least, on the dark Bodies side, which hath not wings to soar into the region of Intellectual light. By those principles, we have traced out the course and progress of all operations belonging to Sense; and how Beasts do or may perform all their actions, even to their most refined and subtilest operations: but, beyond them, we have not been able to carry these grounds, nor they us. Let him then take the pains to shew us, by what Figures, by what First Qualities, by what Mixtion of Rare and Dense parts, an Universal Apprehension, an evident Judgment, a legitimate Consequence is made : and the like of a mans determination of himself to answer pertinently any question; of his choosing this way before that, &c. Which if he can do (as I am sure he cannot) I shall allow it to be reason, and not obstinacy that works in his mind, and carrys him against our Doctrine. But if he cannot, and that there is no appearance nor possibility (as indeed there is not) that these actions can be effected by the ordering of material parts; and yet he will be still unsatisfy'd, without being able to tell why, (for he will be unwilling to acknowledg, that these abstracted Speculations do not sink into him, and that nothing can convince him but what his Senses may be judges of, and he may handle and turn on every side like a brick or tile) and will be still importune with cavillous scruples and wild doubts, that, in truth and at the bottom, signifie nothing : we will leave him to meditate at his leisure upon what we have said; while we proceed on to what follows out of this great principle, *That Our Soul is Incorporeal and Spiritual.*



## C H A P. IX.

*That our Soul is a Substance, and Immortal.*

**H**AVING concluded that our Soul is immaterial and indivisible: (to proceed one step further) it cannot be deny'd, but that it is either a Substance or an Accident. If the later, it must be of the nature of the substance whose accident it is; for so we see all accidents are: but, in man, when his Soul is excluded, there is no spiritual substance at all, wherof we have any notice; and therefore, if it be an accident, it must be a corporeal one, or some accident of a body, (as, some figure, temperature, harmony, or the like) and consequently, divisible: but, this is contrary to what is proved in the former Chapters: and therefore it cannot be a corporeal accident. Neither can it be a spiritual accident; for, to what spiritual substance should it belong, when as nothing in man can be suspected to be spiritual, but it self. Seeing then that it can be no accident, a substance it must be; and must have its Existence or Being in it self.

Here we have passed the Rubicon of experimental knowledg; we are now out of the bounds that experience hath any jurisdiction over: and from henceforth, we must in all our searches and conclusions rely only upon the single evidence of Reason. And even this last conclusion we have been fain to deduce, out of the force of abstracted reasoning upon what we had gather'd before; not by immediate reflection upon some action we observe proceeding from a man: yet, withal, nature flashes out, by a direct beam, some little glimmering of the verity of it, to the eye of Reason within us. For as, when we see a Clock move, or a Mill, or any thing that goes by many wheels; if we mark that there are two contrary motions in two divers parts of it, we cannot think that those contrary motions belong to one and the same continued body: but shall presently conclude, there must be in that Engine two several bodies compacted together. So, in Man, though his Body be the first mover that appears to us, yet seeing that, in his actions, some effects shew themselves, which

1.  
That mans  
Soul is a  
Substance.

2.  
That man is  
compounded  
of some other  
Substance be-  
sides his Body.



which 'tis impossible should proceed from a Body ; 'tis evident, that in him there is some other thing besides that one which we see. And consequently, we may conclude, that he is composed of a Body, and somewhat else that is not-a-Body : which somewhat else, being the spring from whence those actions flow that are of a different strain from those derived from the body, must necessarily be a Spiritual Substance.

3.  
That the Soul  
subsists of it  
self independ-  
ently of the  
Body.

But, while we are examining, how far our present considerations and short discourses may carry us, as it were, experimentally, to confirm this truth ; we must not omit what *Avicenna* (in his Book *De Anima & Almahad*) and *Monſier des Cartes* (in his *Method*) press upon the same occasion. Thus they say, or to like purpose. If I cast with my self, who I am that walk, or speak, or think, or order any thing : my reason will answer me, that, although my legs or tongue were gone, and that I could no longer walk or speak, yet were not I gone ; and I should know and see with my understanding, that I were still the very same thing, the same Ego as before. The same, as of my tongue or legs, would reason tell me of my eys, my ears, my smelling, tasting and feeling, either all of them together, or every one of them single ; that, were they all gone, still should I remain. As when, in a dream, (where I use none of all these) I both am and know my self to be. Reason will tell me also, that although I were not nourished, so I were not wasted, (which for the drift of the argument may be supposed) yet still I should continue in Being. Whence it would appear, that my heart, liver, lungs, kidneys, stomach, mouth, and what other parts of me soever, that serve for the nourishment of my body, might be sever'd from me ; and yet I remain what I am. Nay, if all the beautiful and airy fantasms, which fly about so nimbly in our brain, be nothing else but signs to and in our Soul, of what is without us ; 'tis evident, that, though peradventure she would not, without their service, exercise that which by error we mis-name Thinking, yet, the very same Soul and Thinker might be without them all : and consequently, without brain also ; seeing that our brain is but the play-house and scene, where all these faery masks are acted. So that, in conclusion, Reason assures us, that, when all Body is abstracted in us, there still remains a Substance, a Thinker, an Ego, or I ; that in it self is no whit diminished, by being (as I may say) strip'd out of the case it was inclos'd in.

And



And now, I hope, the intelligent Reader will conceive I have perform'd my promise, and shewed the Soul of man to be an Immortal Substance. For, since it is a Substance, it hath a Being; and since it is an immaterial Substance, it hath a Being of its own force, without needing a consort body, to help it sustain its Existence: for, to be a substance, is to be the subject of Existence; and consequently, to be an immaterial substance is to be a subject capable of Existence, without the help of matter or Quantity. It cannot therefore be required of me, to use any further industry, to prove such a Soul, immortal; but who will contradict her being so is obliged to shew that she is mortal: for it follows in reason, that she will keep her Being, unless by some force she be bereav'd of it. It being a rule, that whoever puts a thing to be is not bound, for the continuation of that things Being, to prove that it is not changed; but on the other side, he, that avers it changed, is bound to bring in his evidence of a sufficient cause to change it: for, to have a thing remain is natures own dictamen, and follows out of the causes which gave it Being; but to make an alteration supposes a change in the causes, and therefore the obligation of proof lyes on that side.

Nevertheless to give satisfaction to those, who are earnest to see every article positively proved; we will make that part to our Province. Let us then remember, that Immortality signifies a negation, or not-having of Mortality: and that a positive term is required to express a change by; since nature teaches us, that whatever is will remain with the Being it hath, unless it be forced out of it. If then, we shew, that Mans Soul hath not those grounds in her, which make all things we see to be mortal; we must be allow'd to have acquitted our selves of the charge, of proving her Immortal. For this end, let us look round about us, and inquire of all the things we meet with, by what means they are changed, and come to a period and are no more, The pure Elements will tell you, that they have their change by rarefaction and condensation, and no otherwise: Mixed bodies, by alteration of their mixture: Smal bodies, by the activity of the Elements working upon them; and by the means of rare-

4.  
Two other Arguments to prove the same: one positive, the other negative.

5.  
The same is proved, because the Soul cannot be obnoxious to the cause of immortality.



faction and condensation entring into their very constitution, and breeding another temperament, by separation of some of their parts, and in their stead mingling others. Plants, and trees and other living creatures will tell you, that their nourishment being insinuated through their whole bodies by subtile pores and blind passages; if they either be stop'd by any accident, or else fill'd with bad nourishment, the mixture of the whole fails of it self, and they come to die. Those things which are violently destroy'd, we see are made away, for the most part, by division: so fire by division destroyes all that comes in its way; so living creatures are destroy'd, by parting their blood from their flesh, or one member from another, or by the evaporation or extinction of their natural heat. In fine, we are sure that all things, which within our knowledg lose their Being, do so by reason of their Quantity; which by division, or by rarefaction and compression, gains some new temperature, that doth not consist with their former temper. After these premisses, I need say no more: the conclusion displays it self readily and plainly, without any further trouble. For, if our labour hath been hitherto, to shew that our Soul is indivisible; and that her operations are such as admit not quantitative parts in her; 'tis clear, she cannot be mortal by any of those ways, wherby we see things round about us to perish.

The like argument we may frame out of Local motion. For, seeing that all the alterative actions we are acquainted with be perform'd by local motion (as is deliver'd, both in gross, and by retail, in our first Treatise); and that *Aristotle* and all understanding Philosophers agree, there can be no Local motion in an indivisible thing, (the reason wherof is evident, to whomsoever reflects upon the nature of Place, and of Local motion): 'tis manifest, there can be no motion to hurt the Soul, since she is concluded to be indivisible.

6.  
The same is  
proved, be-  
cause the Soul  
hath no con-  
trary.

The common argument likewise used in this matter amounts to the same effect; to wit, that, since things are destroy'd only by their contraries, that thing which hath no contrary is not subject to destruction (: which principle both Reason and Experience every where confirm :): but a humane Soul is not subject to contrariety: therefore such an one cannot be destroy'd.



stroy'd. The truth of the assumption may be known two ways : First, because all the contrarieties, that are found within our cognisance, rise out of the primary opposition of Rarity, and Density ; from which the Soul being absolutely free, she likewise is so, from all that grows out of that root : and Secondly, we may be sure, that our Soul can receive no harm from contrariety, since all contraries are so far from hurting her, as contrary wise, the one helps her in the contemplation of the other. And as for contradiction in thoughts, which at different times our Soul is capable of admitting, experience teaches us, that such thoughts change in her, without any prejudice to her substance ; they being accidents, and having their contrariety only betwixt themselves within her, but no opposition at all to her ; which only is the contrariety that may have power to harm her : and therefore, whethersoever of such contrary thoughts be in the Soul, pertains no more to her subsistence, than it doth to the subsistence of a Body, whether it be here or there, on the right hand, or on the left.

And thus I conceive my task is perform'd ; and that I am discharg'd of my undertaking, to shew the Souls Immortality ; which imports no more, than to shew, that the causes of other things mortality do not reach her. Yet, being well perswaded, that my Reader will not be offended with the addition of any new light, in this dark subject ; I will strive to discover (if it be possible) some positive proof, or guess, out of the property and nature of the Soul it self, why she must remain, and enjoy another life after this, To this end, let us cast our eye back, upon what hath been already said, concerning her nature. We found that Truth is the natural perfection of Mans Soul ; and that she cannot be assured of truth naturally, otherwise than by evidence : and therefore, 'tis manifest, that evidence of truth is the full compleat perfection, at which the Soul doth aim. We found also, that the Soul is capable of an absolute infinity of truth or evidence. To these two, we will add only one thing more, which of it self is past question, and therefore needs no proof ; and then we will deduce our conclusion : and this is, that a mans Soul is a far nobler and perfecter part of him, than his Body ; and therefore, by the rules of nature and wisdom, his Body was made for his Soul, and not his Soul finally for his Body.

These

7.  
The same is proved from the end for which the Soul was created.



These grounds being thus lay'd, let us examine, whether our Soul doth in this life arrive to the end she was ordain'd for, or no? and if she do not, then it must follow of necessity, that our Body was made but for a passage, by which our Soul should be ferried over into that state, where she is to attain to that end for which her nature is fram'd and fited. The great skill and artifice of Nature shewing and assuring us, that she never fails of compassing her end, even in her meanest works: and therefore without doubt she would not break her course in her greatest; whereof man is absolutely the head and chief, among all those we are acquainted with. Now, what the end is, to which our Soul aym, is evident; since the perfection of every thing in the end for which it is made: the perfection then, and end of the Soul being evidence, & she being capable of infinite evidence; let us inquire, whether in this life she may compass it or no. To determine this question, let us compare infinite evidence, to that evidence, which the greatest and most knowing man that ever lived hath acquir'd by the work of nature alone; or to the evidence, which by aym we may imagine possible ever to happen any one man should arrive to: and, balancing them well together, let us judg whether all that any man can know here is not, in respect of what a mans Soul is capable of, to be stiled as nothing, and, deserves not the name of evidence, nor to be accounted of that nature. And if our sentence conclude upon this let us acknowledg that our Soul arrives not to her perfection, nor enjoys her end in this world; and therefore, must have infallibly an other habitation in the next world, to which nature intends her. Experience teaches us, that we cannot fully comprehend any one of natures works: and those Philosophers, who in a disciplinable way search into nature, (& therefore are called) *Mathematicians*, after they have written large volums of some very slender subject, ever find, that they have left untouch'd an endless abyss of knowledg, for whomsoever shall please to build upon their foundations; & that they can never arrive near saying all that may be said of that subject, though they have said never so much of it. We may not then make difficulty to believe, that the wisest and learnedest men in the world have reason to profess, with the father of Philosophers, that indeed they know nothing. And if so, how far are they



they from that happiness & perfection: which consists in knowing all things? Of which full sea, we nevertheless find, even in this low ebb, our Soul is a chanel capable; and is framed a fit vessel and instrument to receive it, when the tide shall come in upon it: which we are sure it can not do till the banks of our Body, which hinder it, be broken down.

This last consideration, without doubt, hath added no small corroboration to our former proofs; which are so numerous & so clear, as peradventure it may appear superfluous, to say any more to this point: since one convincing argument establishes the verity of a conclusion, as efficaciously as a hundred; & therefore Mathematicians use but one single proof in all their Propositions, after which other supernumerary ones would be but tedious. Nevertheless, since all the several ways, by which we may look into the nature of our Soul, (the importantest subject we can busie our thoughts upon), cannot fail of being pleasing and delightful to us; we must not omit to reflect a little upon that great property of our Soul, by which she is able to move & to work, without her self being moved or touched. To which adding, that all Life consists in motion, and that all motion of Bodies comes from some other thing without them: we may evidently conclude, that our Soul, who can move without receiving her motion from abroad, hath in her self a spring of life; for which she is not beholding (as Bodies are) to some extrinsecal cause of a nature like to her, but only to him, who gave her to be, what she is. But, if she have such a spring of Life within her, it were unreasonable to imagine, that she died upon the occasion of the death of another thing, that exercises no action of life, but as it is caused by another.

Neither we may neglect that ordinary consideration, which takes notice, that our Soul makes use of Propositions of *eternal truth*: which we have above produced, among our proofs for her being of a *spiritual* nature: and shall now imploy it for the proving her *Immortal*; by considering, that the notion of Being, which settles these Propositions so, as they fear no mutation or shaking by time, is the very riot of the Soul, & that which gives her nature, & which shews it self in all her operations. So that, if from Being arrives to these Propositions, to fear no time, the like must of necessity betide also the sub-

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stance

8.

The same is proved because she can move without being moved.

9.

The same is proved from her manner of operation which is grounded in being.



stance of the Soul. And thus we see that her nature is out of the reach of time : that she can comprehend time, and set it limits; can think of things beyond it, and cast about for them. All which are clear testimonies, that she is free and secure from the all-devouring and destroying tyranny of that Saturnial Conqueror of the whole world of matter and of Bodies, whose servant is Death.

10.  
Lastly, it is proved from the Science of Morality; the principles wherof would be destroy'd, if the Soul were mortal.

After all these proofs drawn from the nature of the Soul it self, every one of them of force to convince her Immortality; I must crave leave to add one consideration more, though it seems to belong to anothers harvest, namely, to the Science of *Morals*: and it is, that the position of mortality in the Soul takes away all morality, and changes men into beasts; by taking away the ground of all difference in those things, which are to govern our actions. For, supposing that the Soul dyes with the Body; and seeing that man hath a comprehension or notion of time without end; 'tis evident, that the span of this life must needs appear contemptible, to him that well considers and weighs it against the other infinite duration. And by consequence, all the goods and evils, which are parts of this life, must needs become as despicable and inconsiderable : so that better or worse in this life hath not any appearance of difference between them; at least, not enough to make him labour with pain to compass the one, and eschew the other, and, for that end, to cross his present inclination in any thing, and engage himself in any the least difficult task. And so it would ensue, that if, to an understanding man, some course or actions were proposed, as better than that he were going about, or for the instant had a mind to; he would relish it, as a great Merchant, or a Banquier would do, whom, dealing for Millions, one should presse with earnestness, to change his resolved course, for the gain of a farthing more this way than the other : which being inconsiderable, he would not trouble his head with it, nor stop at what he was in hand with. In like manner, whoever is perswaded, that for an infinite of time he shall be nothing & without sense of all things; he scorns, for this little twinkling of his life, to take any present pains to be in the next moment well, or to avoid being ill: since in this case, dying is a secure remedy to any present evil; and he is as ready to die now, as a hundred years hence. Nor can he  
esteem



esteem the loss of a hundred years to be a matter of moment; and therefore he will, without any further guidance or discourse, betake himself to do whatever his present inclination bears him to, with most facility: upon this resolution, that, if any thing cross him, he will presently forgo his life, as a trifle not worth the keeping. And thus, neither virtue, nor honor, nor more pleasure, than what at the present tickles him, falls into his account: which is the overthrow of the whole body of Morality, that is, of Mans Action and Nature. But, all they who look into Sciences cross that for an erroneous and absurd position, which takes away the Principles of any Science: and consequently, the position of the Souls Mortality is to be esteem'd such. There remains yet one consideration more, and peradventure more important, than any we have yet mention'd, to convince the Souls Immortality; which is, that spiritual things are in a state of Being: But we shall not be able to declare this, till we have proceeded a little further.

## CHAP. X.

*Declaring what the Soul of a Man, separated from his Body, is: and of her knowledg and manner of working.*

**U**Nhappy man! how long wilt thou be inquisitive and curious to thine own peril? Hast thou not already paid too dear, for thy knowing more, than thy share? Or hast thou not heard, that *Who will pry into Majesty, shall be oppressed by the glory of it?* Some are so curious (shall I say?) or so ignorant, as to demand, what a humane Soul will be, after she is deliver'd from her Body: and unless they may see a picture of her, and have wherby to fantasie her, they will not be perswaded but that all are dreams, which our former discourses have concluded. As if he, who finds himself dazled with looking upon the Sun, had reason to complain of that glorious body; and not of his own weak eyes, that cannot entertain so resplendent a light.

Wherefore, to frame some conceit of a *separated Soul*; I will endeavour, for their satisfaction, to say somewhat of her *future state*. Let us then first consider what a *thought* is. I do not mean that corporeal spirit, which beats at our common sense: but that

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which

I.  
That the Soul is one simple knowing Act, which is a pure substance, and nothing but substance.



which is within, in the inward Soul; whose nature we find by discourse and effects, though we cannot see it in it self. To this purpose we may observe, that if we are to discourse or do any thing, we are guided the right way, in that subject we have in hand, by a multitude of particular thoughts, which are all of them terminated in that discourse or action: and consequently every act of our mind is, as it were, an actual rule or direction, some part of such discourse or action: so that we may conceive a *compleat thought* (compounded of many particular ones) to be a thing, that orders an entire discourse or action of our life.

A *thought* being thus described, let us in the next place try, if we can make an apprehension, what a Science or an Art is: as what the Science of Astronomy, or the *Art of playing on the Organs* is, when the Astronomer thinks not of the motions of the Heavens, nor the Organist of playing on his instrument; which science and art, nevertheless, even then, resides in the Astronomer and Organist. And we find, that these are but the results of many former compleat thoughts: as being those very thoughts in remainder; whatever this may signify.

Lastly, Let us conceive (if we can) a power or capacity to being. To which capacity, if any Being be brought 'tis unseparably glew'd and riveted to it, by its very being a *being*; and if any two things be brought to it, by the virtue of one being common to both those things that both of them, by this one being, become one betwixt themselves and with this capacity. And that so there is no end or period of this addition of things, by the mediation of being; but that, by links & rings, all the things that are in the world, may hang together betwixt themselves; and to this power: if all of them may be brought to it by the Glew and virtue of being; in such sort as, we have formerly declared, passes in the Soul.

Now let put this together, and make up such a thing, as grows out of the capacity to Being thus actuated, & cleaving to all things that any way have being: and we shall see, that it becomes a whole entire World, order'd and clinging together with a great strength and necessity, as can proceed from the nature of being & of contradiction. And our reason wil tell us, that



that such a thing, if it be active, can frame a World, such as we live in, and are a smal parcel of, if it have matter to work on: and can order whatever hath Being, any way that it is capable of being order'd; to do by it, and make of it, whatever can be done by and made of such matter.

All these conceptions (especially by the assistance of the last) may serve a little to shadow out a *perfect Soul*; which is, A knowledg, an art, a rule, a direction of all things: and all this by being all things, in a degree & strain proper and peculiar to it self. And, an *imperfect Soul* is a participation of this Idea: that is, a knowledg, a rule, and a direction; for as much as it is, and as it attains to. Now, as, in our thoughts, it is the corporeal part only which makes a noise and shew outwardly; but the spiritual thought is no otherwise perceiv'd, than in its effect, ordering the bodily acts: so, we must not conceive this knowledg to be a motion, but meerly a thing or Being, out of which the ordering and moving of other things flows; it self remaining fixed and immoveable. And because all that is joyn'd to it is there riveted by Being, or *identification*; and that, when one thing is an other, the other is again it; tis impossible, that one should exceed the other, and be any thing that is not it; and therefore in the Soul there can be no parts, no accidents, no additions, no appendences, nothing that sticks to it and is not it; but whatever is in her, is Soul, and the Soul is all that which is within her. So that all that is of her, and all that belongs to her, is nothing but one pure simple Substance; peradventure Metaphysically or formally divisible, (in such sort as we have explicated in the first Treatise, of the divisibility between quantity and Substance) but not quantitatively, as Bodies are divisible. In fine, Substance it is, and nothing not Substance; all that is in it, being joyn'd and imp'd into it, by the very nature of Being, which makes Substance. This then, is the substantial conceit of a *Humane Soul* strip'd of her Body.

Now, to conceive what proprieties this Substance is furnish'd with, let us reflect on the notions we frame of things, when we consider them in Common: as, when we think of a man, of bread, of some particular virtue, of a vice, or of whatever else. And let us note how, in such, our discourse detemines no place, nor time: nay, if it should, it would marr the discourse; as Logicians shew;

G g g 3

when

2.  
That a Separated Soul is in no place and yet is not absent from any place.



when they teach us, that Scientificall Syllogisms cannot be made without Universal propositions. So that we see, unless these things be strip'd from Place and Time, they are not according to our meaning : and yet nevertheless, we give them both the name and nature of a Thing, or of a Substance, or of a living Thing, or of whatsoever else may, by manner of our conceiving or endeavors, be freed from the subjection to Time and Place. Thus then we plainly see, that it is a very different thing, to be, and to be in a place : and therefore, out of a Things being in no Place, it cannot be infer'd, *That* it is not, or is no Substance; nor contrariwise, out of its being, can it be infer'd, that it is in a Place. There is no man but of himself perceives the false consequence of this Argument, *A thing Is, therefore it is Hot, or Cold;* and the reason is, because hot and cold are particular accidents of a body ; and therefore a body can be without either of them. The like proportion is between Being in general, and Being a Body, or, Being in a Body ; for both these, are particulars in respect of *Being* : but, *to be in a place* is nothing else, but *to be in a circumstant Body* ; and so, what is not in a Body is not in a Place : therefore, as it were an absurd illation to say, it is, therefore *it is in a Body*; no less is it to say, it is, therefore it is somewhere, which is equivalent to, in some Body. And so a great Master (peradventure one of the greatest and judiciousst that ever have been) tells us plainly, that of it self 'tis evident, to those who are truly learned, that Incorporeal Substances are not in Place : and *Aristotle* teaches us, that the Universe is not in Place.

B. etius.

But now, to make use of this discourse, we must intimate what 'tis we level at, in it. We direct it to two ends, First, to lead on our thoughts, and help our apprehension, in framing some conception of a Spiritual Substance, without residence in Place; and to prevent our fancies checking at such abstraction, since we see that we use it in our ordinary speech, when we think not on it, nor labour for it in all universal and indefinite terms: Next, to trace out an eminent propriety of a Separated Soul; namely, that she is no where, and (yet upon the matter) every where; that she is bound to no place, and yet remote from none; that she is able to work upon all, without shifting from one to another or coming neer any ; and that she is free from all, without removing or parting from any one.



A second propriety, not much unlike the first, we shall discover in a Separated Soul, if we compare her with *Time*. We have heretofore explicated, how *Time* is the motion of the Heavens; which give us our motion, which measures all particular motions, and which comprehends all bodies and makes them awaite his leisure. From the large Empire of this proud Commander a Separated Soul is free. For, though she consist with time, (that is to say, she is, while *time* is;) yet is she not in time, nor in any of her actions expects time: but she is able to frame *time*, to spin or weave it out of her self, and master it.

All which will appear manifestly, if we consider what it is to be in time. *Aristotle* shews us, that, to be comprehended under time, or to be in time, is, to be one of those moveables, whose being, consisting in motion, takes up but a part of time, and hath its terms, before and behind, in time, is measured by it, and must expect the flowing of it, both for being and action. Now, all this manifestly belongs to Bodies; whose both action and being is subject to a perpetual local motion and alteration: and consequently a Separated Soul, who is totally a being, and hath her whole operation altogether (as being nothing but her self, when we speak of her perfective operation,) cannot be said to be in time, but is absolutely free from it; though time glide by her, as it doth by other things. And so, all that she knows or can do, she does and knows at once, with one act of the understanding; or rather she is, (indeed and really) all that: and therefore she doth not require time to manage, or order her thoughts, nor do they succeed one another, by such vicissitudes as men are forced to think of things by; (because their fanisie and the Images in it, which beat upon the Soul to make her think whiles she is in the body, are corporal and therefore require time to move in and give way to one another): but she thinks of all the things in the world, and of all that she can think of, together and at once; as hereafter we intend to shew.

A third propriety we may conceive to be in a Separated Soul, by apprehending her to be an activity, which that we may rightly understand, let us compare her, in regard of working with a Body, Reflecting then upon the nature of Bodies, we shall find,

3.  
That a Separated Soul is not in time, nor subject to it.

4.  
That the Soul is an active substance and all in it is activity.



that not any of them will do the functions they are framed for, unless some other thing stir them up and cause them so to do. As for example; a Knife, if it be thrust or pressed, will cut, otherwise, it will lye still and have no effect: and as it fares with a knife, so with those bodies, which seem most to move themselves; as, upon a little consideration, will appear plainly. A Beast seems to move it self: but if we call to mind what we have delivered upon this subject ( in the First Treatise ), we shall find that, when ever he begins to move, he either perceiv's something by his Sense, which causes his motion; or else he remembers something that is in his brain, which works the like effect. Now, if Sense presents him an object that causes his motion, we see manifestly it is an external cause which makes him move. But, if Memory do it, we shall find that stirr'd by some other part; as, by the stomach, or the heart, which is empty, or heated, or hath receiv'd some other impression from another body; so that, sooner or later, we shall discover an outward mover. The like is in natural motions: as, in Heavy things, their easie following (if they be sucked) another way, than downwards testifies, that their motion downwards hath an extrinsecal motor; as is before declared. And not only in these, but throughout, in all other corporal things. So that, in a word, all Bodies are of this nature, that, unless some other thing press and alter them, when they are quiet, they remain so, and have no activity, otherwise than from an extrinsecal mover: but of the Soul, we have declared the contrary and that, by its nature, motion may proceed from it, without any mutation in it, or without its receiving any order, direction, or impulse from an extrinsecal cause.

A Description  
of the Soul.

So that, now, suming up together all we have said upon this occasion we find a Soul, exempted from the Body, to be, An indivisible Substance, exempted from Place and Time, yet present to both: an actual and present knowledg of all things that may be known: and a skil or rule, even by what it self is, to all things whatever. This she is, if she be perfect: but if she be imperfect, then is she all this to the proportion of her growth (if so I may say); and she is powerful, according to the measure of her knowledg, and of her will. So that, in fine, a Separated Soul is of a nature to have, and to know, and to govern all things.



I may reasonably suspect, that my saying, how imperfect Souls are rules to the proportion of their growth, may have occasion'd great reflection, and bred some trouble in the curious and heedful Reader. I confess this expression was deliver'd by me, only to free my self for the present from the labour of shewing what knowledg every Separated Soul hath : but, upon second thoughts, I find that such sliding over this difficult point will not serve my turn, nor save me the pains of untying this knot ; for, unless I explicate what I mean by that speech, I shall leave my Reader in great doubt and anxiety. Which to free him from, I must wade a little further in this question, of the extent of a separated Souls knowledg ; into which I have thus, upon the by, engaged my self. But, let him first be advertis'd, that I do not here meddle with what a Separated Soul may know by Revelation, or by Supernatural means : but that I only track out her natural paths ; and guess at what she is, or knows, by that light which her conversation in her body affords us.

Our entrance into this matter must be, to consider what mutation, in respect of knowledg, a Soul's first change out of her Body makes in her : for, it is not unlikely, but nature may some way enlighten us so far, as to understand what must follow out of the negation of the Bodies consortship, added to what we know of her and Natures other works in this world. This then first occurs, that surely she cannot choose but still know, in that state, all that she knew while she was in the Body ; since we are certain, the Body hath no part in that which is true knowledg : as is above declared, when we shew'd, first, that all true knowledg is respective ; secondly, that the first impressions of the fancy do not reach to the interiour Soul ; and lastly, that she works by much more, than what hath any actual correspondence in the fancy ; and that all things are united to her by the force of Being. From which last it follows, that all things she knows are her self ; and she is all that she knows : wherefore, if she keeps her self and her own Being, she must needs keep the knowledg of all that she knew in this world.

6.  
That a Separated Soul knows all that which she knew whilst she was in her Body.

Next:



5.  
That the least  
knowledg  
which the Soul  
acquires in  
her body, of  
any one thing,  
causes in her,  
when she is  
separated from  
her body, a  
compleat  
knowledg of  
all things  
whatever.

Next, she must undoubtedly know, then, somewhat more than she knew in the Body. For, since, out of the things she already knows, others will follow, by the meer ordering and connexion of them; and the Souls proper work *is*, to order things: we cannot doubt, but that both the things she knows in this world must of necessity be order'd in her to the best advantage; and likewise, that all that will be known, which wants no other cause for the knowing of it, but the ordering of these things. For, if the nature of a thing were Order, who can doubt, but what were put into that thing were put into Order? Now, that the nature of the Soul is such, we collect easily. For, since all order proceeds from her, it must be acknowledg'd that Order is first in her: but, what is in her is her nature: her nature then is Order, and what is in her is order'd. In saying of which, I do not mean that there is such an order between the notions of a Separated Soul, as is between material things that are order'd by the Soul while she is in the Body: for, since the Soul is an adæquate cause of such order, (that is to say, a cause which can make any one such, and the whole kind of it), it follows, that such order is not in her, for, if it were, she would be cause of her self, or of her own parts. Order therefore in her must signifie a thing more eminent, than such inferiour Order: in which resides the power of making that inferiour Order: and this is nothing else, but the connexion of her notions by the necessity of Being; which we have often explicated. And, out of this eminent or superiour kind of Order, our conclusion follows no less, than if the inferiour Order, which we see in our fancies while our Soul is in our Body, did reside in our interiour Soul: for, it is the necessity of identification which doth the effect, and makes the Soul know; and the order of fantasms is but a precedent condition in the bodily Agent, that it may work upon the Soul: and, if more fantasms than one could be together, this order would not be necessary.

Out of this, a notable and vast conclusion manifestly follows: to wit, that if a Soul can know any one thing more when she is out of the Body, than what she knew while she was in the Body; without any manner of doubt, she knows all that can be



be drawn and forced out of these knowledges which she had in her Body. How much this is, and how far it will reach, I am afraid to speak. Only I intreat Mathematicians, and such as are acquainted with the manner how Sciences proceed, to consider how some of their Definitions are made; to wit, by composing together sundry known terms, and giving a new name to the compound that results out of them: Wherefore, clear it is, that, out of fewer notions had at the first, the Soul can make many more; and, the more she hath or makes, the more she can multiply. Again, the Maximes, which are necessary to be added to the Definitions for gaining of knowledg, we see are also compounded of ordinary and known terms: So that a Separated Soul can want neither the Definitions, nor the Maximes, out of which, the Books of Sciences are composed, and therefore, neither can the Sciences themselves be wanting to her. Now, if we consider, that, in the same fashion as Demonstrations are made, and knowledg is acquired in one Science, by the same means there is a transcendence from Science to Science; and that there is a connexion among all the Sciences, which fall into the consideration of man, and indeed among all (at least, corporal) things (for of spiritual things we cannot so assuredly affirm it, though their perfection may perswade us, that there is rather a greater connexion among them, than among corporal things): it will follow, that a Soul, which hath but any indifferent knowledg in *This World*, shall be replenish'd with all knowledg in the *Next*.

But, how much is this indifferent knowledg, that for this purpose is requir'd in this world? Upon mature consideration of this point, 'tis true, I find it absolutely necessary, that the Soul must have here so much knowledg, as to be able to determine that some one thing, which hath connexion with all the rest, *is in such a time*: But then, why, out of this very conception, she should not be able to climb up by degrees, to the knowledg of all other things whatever since there is a connexion between that and all the rest, and no untransferrable Gap or Chaos to sever them), I profess I do not see. Which if it be so, then the Soul of an Abortive in his Mothers Womb (if he once arrive to have Sense and, from it, to receive any impression in his Soul) may, for  
ought



ought I know or can suspect to the contrary, be endew'd in the next world with as much knowledg, as the Soul of the greatest Clerk that ever lived : and, if an abortive do not arrive so far, as to the knowledg of some one thing, I know no reason why we should believe it arrived to the Nature of Man.

Whence it follows, that this amplitude of knowledg is common to All Humane Souls, (of what pitch soever they seem to be here), when they are separated from their Bodies : as also, that, if any Error have crept into a mans judgment, during this life (whether it be of some universal conclusion, or of some particular thing) all such will be abolish'd then, by the Truth appearing on the opposite side ; since two contradictory judgments cannot possess our Soul together, as, even in this world, as well Experience as Reason teaches us.

8.  
An answer to  
the objections  
of some Peri-  
pateticks, who  
maintain the  
Soul to perish  
with the Body.

But unawares I have engulf'd my self into a Sea of contradictions, from no mean Adversaries : for *Alexander Aphrodisiens*, *Pomponatius*, and the learnedest of the Peripatetick School will all rise up in main opposition against this doctrine of mine. Shewing how, in the Body, all our Soul's knowledg is made by the working of our fancy ; and that there is no act of our Soul without speculation of fantasms residing in our memory : therefore, since, when our Body is gone, all those little Bodies of fantasms are gone with it ; what sign is there that any operation can remain ? And hence they infer, that since every substance hath its Being for its operations sake, and by consequence were vain and superfluous in the world, if it could not enjoy and exercise its operation ; there is no necessity or end, why the Soul of a man should survive his Body : and consequently, there is no reason to imagine other, than that it perishes when the man dies. This is the substance of their Argument ; which indeed is nothing else, but to guess without ground ; or rather against all ground. But however, this is my comfort, that I have to do with Peripateticks ; men that will hear and answer reason : and to such I address my speech.

To joyn issue then with them, and encounter them with their own weapons ; let us call to mind, what *Aristotle* holds Light to be. He saith, *that it is* A suddain and momentary emanation



nation of what it is, following the precedent motion of some body, but without motion in it self. As for example : when the Sun comes into our Horison, (says he), the illumination of the Horison is an effect in an instant; following from the motion which the Sun had, since his setting in the other Hemisphere, till he appear there again. So that (according to him) the way of making this light is the Sun's local motion; but the effect, or the being enlightned, is a thing of a very different nature, done without beginning, and continuing till the Sun depart again from our Horison. And, he explicates this action of illumination, in the same manner doth he the actions of Sense and of Understanding. Upon all which I urge; that no Peripatetick will deny me, but that, as in every particular sensation or thinking, there precedes a Corporal motion, out of which it ensues : so, this general motion, which we call the life of man, precedes that twinkle or moment, in which his Soul becomes an absolute spirit, or inhabitant of the next world. Wherefore it cannot be said, that we introduce a doctrine aliene from the Peripatetical way of Philosophising; if we put a momentary effect or motion (according to their phrase of speaking) to follow out of the course of Mans Life : since they put diverse such effects to follow out of particular parts of it.

Now, this momentary change, or what they please to call it, is that which makes at one blow, all this knowledg we speak of. For, if we remember that knowledg is not a doing or motion, but a Being, (as is agreed between the Peripateticks and us); they cannot, for the continuing it, require instruments and motors : for, they are necessary only for change, not for Being. Now, all this mighty change, which is made at the Souls delivery, we conceive follows precisely out of the change of her Being. For, seeing it is supposed, that her Being was before in a Body, but is now out of a Body; it must of necessity follow, that all impediments, which grew out of her being in a Body, must be taken away by her being freed from it. Among which impediments one is, that Time is then required betwixt her  
know-



\* *in part*

knowledg of one thing, and her knowledg of another thing : and so her capacity, that of it self is infinite, becomes confined to that small multitude of objects, which the division and straightness of time gives way to. Now, that which length of time could ~~have~~ work in the body, the same is intirely done in a moment, by the changing of her manner of Being : for, by taking away the bonds, by which she was enthrall'd in the body, kept in to apprehend but according to its measure, and constrain'd to enjoy her self (as it were) but at the Bodies permission ; she is put in free possession of her self, and of all that is in her. And this is nothing else, but to have that large knowledg, we have spoken of : for, her knowing all that is no other thing, but her being her self perfectly. Which will appear evident, if we consider, that her nature is to be a Knower, and that Knowledg is nothing else but a Being of the Object in the Knower ; for thence it follows, that to *know all things* is nought else, but to *be all things* : since then we concluded by our former discourse, that all things were to be gather'd out of any one ; 'tis clear, that, to *be perfectly her self* ~~and~~ any one thing is, in truth, to *know all things*.

And thus we see, that for the Soul's enjoying all this knowledg when she is out of the Body, she needs no objects without her, no phantasms, no instruments, no helps : but that all that is requisite is contain'd absolutely in her being her self perfectly. And so we retort our Adversaries Objection on themselves ; by representing to them, that since, in their own Doctrine, they require no body nor instruments, for that precise action which they call Understanding : it is without all ground, for them to require bodies and instruments in the next life ; that the Soul may there be that, which they acknowledg she is in her Body, without any such helps.

And as for that Axiom or Experience, that the Soul doth not understand, unless she speculate phantasms : as, on the one side, I yield to it, and confess the experience, after the best and seriousst trial I could make of it ; so, on the other side,



side, when I examine the matter to the bottom, I find that it comes not home to our Adversaries intention. For as, when we look on a thing, we conceive we work on that thing; whereas in truth we do but set our selves in such a position, that the thing seen may work on us: in like manner, our looking on the phantasms in our brain is not our Soul's action upon them, but our letting them beat at our common sense; that is, our letting them work on our Soul. The effect wherof is, that either our Soul is better'd in her self; as, when we study and contemplate: or else, that she betters something without us; as when, by this thinking, we order any action.

But, if they will have this Axiom avail them, they should shew that the Soul is not of her self a knowledg: which if they be able to do, even then, when, to our thinking, she seems not so much as to think, we will yield they have reason. But that they'll find impossible: for, she is always, of her self, a knowledg; though in the Body she never expresses so much, but when she is put to it. Or else they should shew, that this knowledg, which the Soul is of her self, will not, by changing the manner of her Existence, become an actual knowledg, instead of the habitual knowledg which now appears in her.

But as these *Aristotelians* embrace and stick to one Axiom of their Patron; so they forego and prevaricate against another. For, as it is *Aristotle's* doctrine, that a Substance is for its Operation, and were in vain and superfluous, if it could not practise it: so likewise it is his confessed doctrine, that Matter is for its Form, and not the Form for the Matter. And yet these men pretend that the Soul serves for nothing, but the governing of the body: whereas contrariwise, both all *Aristotle's* doctrine, and common sense, convinces, that the Body must be for the Soul. Which if it be, nothing can be more consentaneous to Reason, than to conceive, that the durance, which the Soul hath in the Body, is assign'd her, to work and mould in her the Future State, which she is to have after this life: and, that no more Operations are to be expected from her after

9.  
The former  
Peripateticks  
refuted out of  
*Aristotle.*



after this life, but, instead of them, a settled state of Being; seeing that, even in this life, according to *Aristotle's* doctrine, the proper operations of the Soul are but certain Being. So that we may conclude, that, if a Soul were grown to the perfection which her nature is capable of, she would be nothing else but a constant Being, never changing from the happiness of the best Being.

And though the Texts of *Aristotle* which remain to us be uncertain (peradventure, not so much because they were originally such in themselves, as through the mingling of some comments into the body of the text;) yet if we had his Book, which he wrote of *the Soul*, upon the death of his friend *Eudemus*, 'tis very likely we should there see his evident assertion of her Immortality; since it had been very impertinent to take occasion upon a Friends death to write of the Soul, if he intended to conclude, that of a dead man there were no Soul.

10.  
The operations  
of a Separated  
Soul compared  
to her opera-  
tions in her  
Body.

Out of this discourse it appears how those Actions, which we exercise in this life, are to be understood, when we hear them attributed to the next: for, to think they are to be taken in their direct plain meaning, and in that way in which they are perform'd in this world, were a great simplicity; and were to imagine a likeness between Bodies and Spirits. We must therefore elevate our minds, when we would penetrate into the true meaning of such expressions; and consider how all the actions of our Soul are eminently comprehended in the Universality of knowledg, we have already explicated. And so, the Apprehensions, Judgments, Discourses, Reflections, Talkings-together, and all other such actions of ours, when they are attributed to separated Souls, are but inadæquate names and representations of their instantaneous sight of all things. For, in that, they cannot choose but see others minds, which is that we call talking, and likewise their own, which we call reflection: the rest are plain parts of, and plainly contain'd in knowledg; discourse being but the falling into it, judgment the principles of it, and single apprehensions the components of judgments.

Then



Then, for such actions as are the beginning of operation, there can be no doubt but that they are likewise to be found, and are resumed, in the same Universality; as, love of good, consultation, resolution, prudential election, and the first motion: for, who knows all things cannot choose but know what is good and that good is to be prosecuted, and, who sees compleatly all the means of effecting and attaining to his intended good hath already consulted and resolv'd of the best, and, who understands perfectly the matter he is to work on hath already made his prudential Election; so that there remains nothing more to be done, but to give the first impulse.

And thus you see, that this Universality of knowledg in the Soul comprehends all, is all, performs all; and no imaginable good or happiness is out of her reach. A noble creature, and not to be cast away upon such trash as most men employ their thoughts in. Upon whom it is now time to reflect; and to consider, what effects the divers manners of living in this world work upon her in the next: if first we acquit our selves of a promise we made at the end of the last Chapter. For, it being now amply declared, that the state of a Soul, exempted from her Body, is a state of pure Being; it follows manifestly, that there is neither action nor passion in that state. Which being so, it is beyond all opposition, that the Soul cannot dye. For, 'tis evident, that all corruption must come from the action of another thing upon that which is corrupted: and therefore, that thing must be capable of Being made better and worse. Now then, if a Separated Soul be in a final state, where she can neither be better'd, or worsened, (as she must be, if she be such a thing as we have declared); it follows, that she cannot possibly lose the Being which she hath. And, since her passage out of the Body doth not change her nature, but only her state; 'tis clear, that she is of the same nature even in the body: though, in this her durance, she be subject to be forged (as it were) by the hammers of corporeal objects beating upon her; yet so, that, of her self, she still is what she is. And therefore, as soon as she is out of the passible oore, in which she suffers by reason of that oore, she presently becomes impassible; as being purely, of

H h h

her



her own nature, a fixed substance, that is, a pure Being. Both which states of the Soul may in some sort be adumbrated, by what we see passes in the coppelling of a fixed metal. For, as long as any lead, or dross, or allay remains with it, it continues melted, flowing, and in motion under the muffle: but, as soon as they are parted from it, and that it is become pure, without any mixture, and singly it self; it contracts it self to a narrower room and, at that very instant, ceases from all motion, grows hard, permanent, resistant to all operations of fire, and suffers no change or diminution in its substance by any outward violence we can use to it.

## CHAP. XI

*Shewing what effects the divers manners of living in this world cause in a Soul, after she is separated from her Body.*

I.  
That a Soul in this life is subject to mutation, and may be perfected in knowledg.

**O**ne thing may peradventure seem of hard digestion in our past discourse: and it is, that, out of the grounds we have laid, it seems to follow, that all Souls will have an equality; since we have concluded, that the greatest shall see or know no more than the least. And indeed, there appears no cause, why this great and noble creature should ly imprison'd in the obscure dungeon of noisom flesh; if, in the first instant, in which it hath its first knowledg, it hath then already gain'd whatever it is capable of gaining, in the whole progress of a long life afterwards. Truly, the Platonick Philosophers (who are perswaded that a humane Soul doth not profit in this life, nor acquired any knowledg here, as being of her self compleatly perfect; and that all our discourings are but her remembrings of what she had forgotten) will find themselvs ill bestead, to render a Philosophical and sufficient cause of her being lock'd into a Body. For, to put forgetfulness in a pure Spirit (so palpable an effect of corporeity, and so great a corruption, in respect of a creature whose nature is to know of it self) is an unsufferable error. Besides, when they tell us she cannot be changed, because all change would prejudice the spiritual nature which they attribute to her, but that well she may be warned and excited by being in a Body



Body; they meerly trifle. For, either there is some true mutation made in her, by that which they call a warning; or there is not. If there be not, how becomes it a warning to her? or what is it more to her than if a straw were wag'd at the *Antipodes*? But, if there be some mutation (be it never so little) made in her, by a corporeal motion: what should hinder, why she may not, by means of her Body, attain to Science she never had; as well as by it receive any the least intrinsecal mutation whatever? For, if once we admit any mutability in her from any corporeal motion; 'tis far more conformable to reason to suppose it, in regard of that which is her natural perfection, and of that which by her operation: we see she hath immediately after such corporeal motions, and wherof before them there appear'd in her no marks at all: than to suppose it in regard of a dark intimation, of which we neither know it is, nor how it is performed. Surely, no Rational Philosopher, seeing a thing, whose nature is to know, have a Being, whereas formerly it existed not, and observing how that thing by little and little gives sign of more and more knowledg; can doubt, but that, as she could be changed from not Being to Being, so may she likewise be changed from less knowing to more knowing.

This then being irrefragably settled, that in the Body she encreases in knowledg; let us come to our difficulty, and examine what this encrease in the Body avails her. Since, as soon as she parts from it, she shall, of her own nature, enjoy and be replenish'd with the knowledg of all things; why should she laboriously strive to anticipate the getting of a few drops, which but encrease her thirst and anxiety: when, having but a little patience, she shall, at one full and everlasting draught, drink up the whole sea of it? We know that the Soul is a thing, made proportionably to the making of its Body; seeing, it is the Bodies compartner: and we have concluded, that, while it is in the Body, it acquires perfection, in that way which the nature of it is capable of, that is, in knowledg; as the Body acquires perfection in its way, which is in strength and agility. Now then, let us compare the proceedings of the one, with those of the other substance; and peradventure we may gain some light, to discern what advantage it may prove to a Soul, to remain long

H h h 2

in

2.  
That the knowledges which a Soul gets in this life will make her knowledg in the next life more perfect and firm.



in its Body, if it make right use of its dwelling there. Let us consider the Body of a Man, well and exactly shaped in all his members : yet, if he never use care nor pains to exercise those well framed limbs of his, he will want much of those corporeal perfections, which others will have who employ them sedulously. Though his leggs, arms, and hands, be of an exact symmetry ; yet he will not be able to run, to wrestle, or to throw a dart, with those who labour to perfect themselves in such exercises. Though his fingers be never so neatly moulded or composed to all advantages of quick and smart motion ; yet, if he never learn'd and practis'd on the Lute, he will not be able with them to make any musick upon that instrument, even after he sees plainly and comprehends fully all that the cunning Lutenist doth : neither will he be able to play as he doth, with his fingers, which of themselves are peradventure less apt to those voluble motions than his are. That which makes a man dexterous in any of these Arts, or in any other operations, proper to any of the parts or limbs of his body, is the often repetitions of the same Acts ; which amend and perfect those limbs in their motions, and make them fit and ready for the actions they are design'd to.

In the same manner it fares with the Soul ; whose essence is that which she knows : her several knowledges may be compared to arms, hands, fingers, leggs, thighs, &c. in a Body ; and all her knowledges, taken together, compose (as I may say) and make her up what she is. Now, those limbs of hers, though they be, when they are at the worst, entire, and well shaped in bulk, (to use the comparison of Bodies) : yet they are susceptible of further perfection, as our corporeal limbs are, by often and orderly usage of them. When we iterate our acts of understanding any object, the second act is of the same nature as the first, the third as the second ; and so of the rest : every one of which perfects the understanding of that thing, and of all that depends on the knowledg of it ; and makes it become more vigorous and strong. Even the often throwing of a Boul at the same mark begets still more and more strength and justness in the Arm that delivers it : for, it cannot be deny'd, but



but the same cause, which makes any thing must of necessity perfect and strengthen it, by repeating its force and strokes. We may then conclude, that the knowledg of our Soul (which is indeed her self) will be, in the next life, more perfect and strong, or more slack and weak; according as, in this life, she hath often and vigorously, or faintly and seldom, busied her self about those things which beget such knowledg.

Now, those things which men bestow their pains to know, we see, are of two kinds: for, Some thirst after the knowledg of Nature, and of the variety of things, which either their senses, or their discourse, tell them of; but Others look no higher, than to have an insight into humane action, or to gain skill in some Art, whereby they may acquire means to live. These later curiosities are but of particulars, that is, of some one or few *species*, or kinds, whose common, that comprehends them, falls within the reach of every vulgar capacity; and consequently, the things which depend on them are low, mean and contemptible: whereas the beauty, vastness, and excellency of the others is so much beyond them, as they can be brought into no proportion to one another. Now then, if we consider, what advantage the one sort of these men will, in the next world, have over the other; we shall find, that they, who spend their life here in the study and contemplation of the first noble Objects, will, in the next, have their universal knowledg (that is, their Soul) strong and perfect: while the others, that play'd away their thoughts and time upon trifles, and seldom rais'd their minds above the pitch of sense, will be faint through their former laziness; like Bodies benum'd with the Palsey, and sickly through their ill diet: as when a well shaped Virgin, that, having fed upon trash instead of nourishing meats, languishes under a wearisom burden of the Green-sickness.

To make this point yet more clear, we may consider how the things, which we gain knowledg of, affect us, under the title of Good and Convenient, in two several manners. One is, when the appearance of Good, in the abstracted nature of it, and after examination of all circumstances, carries

3.  
That the Soul, of men addicted to Science whilst they lived here, are more perfect in the next world than the Souls of unlearned men.

4.  
That those Souls, which embrace Virtue in this world, will be most perfect in the next; and those which embrace Vice most miserable.



our heart to the desire of the thing, that appears so to us: the other is, when the semblance of good to our Own Particular persons, without casting any further, or questioning whether any other regard may not make it prejudicial, causes in us a longing for the thing wherein such resemblance shines. Now, for the most part, the knowledges which spring out of the latter objects, are more cultivated by us, than those which arise out of the other; partly by reason of their frequent occurring, either through necessity or judgment; and partly, by the addition which Passion gives to the impressions they make upon us. For, Passion multiplies the thoughts of such things, more than of any others; if reason do not cross and suppress her tumultuary motions; which, in most men, she doth not. The Souls, then, of such persons as giving way to their passion, in this life busie themselves about such things, as appear good to their own persons, and cast no further, must needs decede from their Bodies unequally builded, (if that expression may be permitted me): and will be like, a lame unwieldy Body, in which the principal limbs are not able to govern and move the others; because those principal ones are faint, through want of spirits and exercise, and the others are overgrown with hydro-pical and nocive humours. The reason whereof is, that, in such Souls, their judgments will be disproportion'd to one another; one of them being unduly stronger than the other. What effect this works, in regard of knowledge, we have already declared: and no less will it have in respect of actions. For, suppose two judgments to be unequal, and such, as in the action one contradicts the other; for example, let one of my judgments be, that it is good for me to eat because I am an hungry, and let the other be, that it is good for me to study, because I am shortly to give an account of my self: if the one judgment be stronger than the other, (as, if that of eating be stronger than that of studying, it imports not that there is more reason (all circumstances consider'd) for studying; because, reasons move to action, according to the measure in which the resolution taken upon them is strong or weak, and therefore my action will follow the strongest



strongest judgment, and I shall leave my book to go to my dinner.

Now, to apply this to the state of a Separated Soul. We are to remember how the spiritual judgments, which she collected in the Body, remain in her, after she is divested of it; and likewise, we are to consider, how all her proceeding in that state is built not upon passion, or any bodily causes or dispositions, but meerly upon the quality and force of those spiritual judgments: and then, it evidently follows, that, if there were any such action in the next life, the pure Soul would apply it self thereto, according to the proportion of her judgments, and as they are graduated and qualified. 'Tis true, there is no such action remaining in the next life; yet nevertheless there remains in the Soul a disposition and a promptitude to such action: and, if we will frame a right apprehension of a Separated Soul, we must conceit her to be of such a nature; for then all is nature with her, as hereafter we shall discourse). as if she were a thing made for action, in that proportion and efficacy; which the quartering of her by this variety of judgments affords; that is, that she is so much the more fit for one action than for another, (were she to proceed to action), as the judgment of the goodness of one of these actions is stronger in her, than the judgment of the others goodness, which is, in effect, by how much the one is more cultivated than the other. And, out of this we may conclude, that what motions follow in a man out of discourse, the like will in a Separated Soul follow out of her spiritual judgments. So that, as he is joy'd if he possess his desired good, and discontented and displeased if he miss of it; and seizes greedily upon it, when it is present to him, and then cleaves fast to it, and whiles he wants it, no other good affects him, but he is still longing after that Master-wish of his heart: the like in every regard, much more vehemently, befalls a Separated Soul. So that, in fine, she will be happy or miserable, according as she built up her self, by her spiritual judgments and affections, in this life. If knowledg and intellectual objects be the goods she thirsts after she what can be happier than she; when she possesses the



fulness of all that can be desired in that kind? But if, in this world, a man settles his heart constantly upon any transitory end; as, upon wealth, corporeal delights, honour, power, and the like, (which are too short breath'd attendants to follow him so long a journey, as into the next): then, all the powers of his Soul, even after she hath left her Body, will be still longing after that dear Idol of her affections; and, for the want of it, she will not value the great knowledg she shall then be indued with, nor care for any good she possesses. Like a man who, being surrounded with a full sea and swollen tide of all specious objects that may please and delight him, hath, by unlucky chance, suffered his violent affections and impotent desires to be intangled in some mean love, that either neglects him, or he is hinder'd from enjoining: and thereby, that little drop of gall, or rather that privation of a mean contentment (which truly in itself is nothing) infects and poysons the whole draught of happiness, that, but for this, would swell him up to the height of his wishes.

5.  
The state of a  
vicious Soul in  
the next life.

But, no comparisons of sorrows, griefs, or anguishes in this life (where our earthly dwelling doth so clog, and allay, and dull the sense of our Soul, which only feels and relishes either delight or wo) can arrive to shadow out the misery of a Separated Soul so affected: whose strains are so excessively vehement, and whose nature is a pure activity, and herself all sense, all knowledg. 'Tis true, I confess, that in a man such motions in part proceed from passion: and therefore, I will allow, that so much of them, as have their origine meerly and only from thence, shal dye with the Body; and not have made any impression in the Separated Soul. But, besides the stream of passion, we may in such motions observe also the work of reason; for she both approves and employes her powers, to compass and gain what the other presents, and by legitimate discourse draws consequences out of that principle or judgment, which makes the byas it then leans to: and these are undeniable effects of a spiritual judgment settled in the Soul. And therefore, as far as these motions proceed from spiritual judgments, so far, 'tis clear, they must remain in the Separated Soul.

Perad-



Peradventure, what I have said, may be liable to a mistake ; as though I conceiv'd that these spiritual judgments are made in the Soul according to right reason, and to legitimate discourse : whereas, I mean nothing less. But, esteeming an overstrong judgment in the Separated Soul to be proportionable to a passion in the Body ; I conceit that, as passion sets reason on work to find out means whereby she may arrive to her ends, so may this judgment set reason on float, with those acts which follow consequently upon it (though inconsequent to the whole body of reason) : because the disorder there is in the excess of this judgment over others, whose force (according to nature) ought to be greater than it. So that, if we would frame a conception of a disorder'd Soul, when it is out of the Body ; we may imagine it correspondent to a Body, whose one part were bigger than could stand in proportion with another : as if the hand (to use the example we brought before) were greater, than the arm could manage, or the foot larger and heavier than the leg and thigh could wield. To which add, that every part were active and working of it self ; so as, though it could not be govern'd, yet would it continually have its own operation : which would be contrary to the operation of the arm or leg, and consequently, it would ever be tending to impossible operations. And by that means, both one member would always disagree from the other, and neither of them attain any effect at all : not unlike the fanſie of the Poets, who fain'd a monster, which the term'd Scylla, whose inferiour parts were a company of Dogs, ever snarling and quarreling among themselves ; and yet were unseverable from one another, as being comparts of the same substance.

But, to declare this important doctrine more dogmatically ; let us consider that, of necessity, a disorder'd Soul hath these following judgments settled in her. Namely, that she is not well, that she cannot be well without her desired good, that it is impossible for her to compass that good ; and lastly, that this state she is in, is by all means possible to be avoided ; not by changing her judgment (for that is her self.)



self,) but by procuring the satisfaction she desires; and this with all the power and total inclination of her activity and possibility. This then being the temper of a disorder'd Separated Soul, it is easie to conceive, what a said condition such an one remains then in; which is infinitely more, than any affliction that can happen to a man in this world: for since even here, all our joys and griefs proceed from our Soul; we must needs allow, that when she shall be free from the burthen of her Body (which doth exceedingly impeach and limit her operations and activity), all her actions, will be then far greater and more efficacious

6.  
The fundamental reason why as well happiness as misery is so excessive in the next life.

But, because this point is of highest consequence, we may not slightly pass it over: but we will endeavour, if we can, to discover the wonderful efficacy and force of a Separated Soul's operations; that from thence we may the better, collect, how great her happiness or misery will be in the next life. Let us then consider, how an Act or judgment of the Soul may be more forcible, either by it self, or by the multiplication of such helps as concur with it. To begin with considering the Act in it self; we know that the certaineſt way to measure the strength of it is, to take a survey of the force, which shews it self in its effect: for, they being relatives to one another, each of them discovers the others nature. Now, this we will doe, after our ordinary manner, by comparing the spir<sup>it</sup>ual effects issuing from a judgment in the Soul, to material effects proceeding from the operations and motions of Bodies. In these we may observe three things, by which we may estimate their efficaciousness: some actions dure a longer time, others take up a greater place, and others again work the like effect in a greater place and in a shorter time; w<sup>h</sup>ich last sort, of all others, proceed from the most powerful and most forcible agents. If then, in these considerations, we compare a Separated Soul to a Body; what an infinity of strength and efficacy will the meanest of those pure substances have, beyond the most powerful and active Body that can be imagined in nature? For, we have already shew'd how a Separated Soul comprehends at once all place, and all times; so that, her activity requires no application



cation to place or time : but, she is, of her self, mistress of both; comprehending all quantity whatever in an indivisible apprehension and ranking all the parts of motion in their compleat and knowing at once, order what is to happen in every one of them, On the other side, an Incorporated Soul, by reason of her being confined to the use her Senses, can look on but one single definite place or time at once; and needs a long chain of many discourses, to comprehend all the circumstances of any one action: and yet after all, how short is she of comprehending all? So that, comparing one of these with the other, 'tis evident, that the proportion of a Separated Soul, to one in the Body is as all time, or all place, in respect of any one piece or least parcel of them; or, as the entire absolute comprehender of all time and all place is, to the discoverer of a small measure of them. For, whatever a Soul wills in that state, she wills it for the whole extent of her duration: because she is then out of the state or capacity of changing, and wishes for whatever she wishes, as for her absolute good; and therefore employs the whole force of her judgment upon every particular wish. Likewise, the eminencie which a Separated Soul hath over place is, also, then entirely employ'd upon every particular wish of hers: since, in that state, there is no variety of place left her, to wish for such good in one place, and to refuse it in another; as, while she is in the Body, hapneth to every thing she desires. Wherefore, whatever she then wishes for, she wishes for it according to her comparison to place: that is to say, that, as such a Soul hath a power to work at the same time in all places, by the absolute comprehension which she hath of place in abstract; so, every wish of that Soul, if it were concerning a thing to be made in place,\* were able to make it in all places; through the excessive force and efficacy which she employs upon every particular wish,

The third effect, by which among bodies we gather the vigour and energy of the cause that produces it; (to wit, the doing of the like actions in a lesser time & in a larger extent, is but a combination of the two former: and therefore it requires no further particular instance upon it, to shew that, likewise in this, the proportion of a Separated to an Incorporated Soul



Soul must needs be the self same as in the other; seeing, a Separated Soul's activity is upon all place is in an Indivisible of time.

Therefore, to shut up this point; there remains only for us to consider, what addition may be made to the efficacy of a judgment, by the concurrence of other extrinsecal helps. We see that, when an understanding man will settle any judgment or conclusion in his mind, he weighs thoroughly all that follows out of such a judgment; and considers likewise all the antecedents that lead him to it: and if, after due reflection and examination of whatever concerns this conclusion which he is establishing in his mind, he finds nothing to cross it, but that every particular and circumstance goes smoothly along with and strengthens it; he is then satisfied and quiet in his thoughts, and yields a full assent therto: which assent is the stronger, the more concurrent testimonies he has for it. And, though he should have a perfect demonstration or light of the thing in it self; yet every one of the other extrinsecal proofs, being, as it were, a new perswasion, hath in it a further vigour to strengthen and content his mind in the fore-had demonstration: for, if every one of these be in it self sufficient to make the thing evident, it cannot happen that any one of them should hinder the others; but contrariwise, every one of them must needs concurr with all the rest, to the effectual quieting of his understanding, in its assent to that judgment. Now then, according to this rate, let us calculate (if we can) what concurrence of proofs and witnesses a Separated Soul will have, to settle and strengthen her in every one of her judgments. We know, that all verities are chain'd and connected one to another; and that there is no true conclusion so far remote from any other, but may, by more or less consequences and discourses, be deduced evidently out of it: it follows then that, in the abstracted Soul, where all such consequences are ready drawn and seen in themselves, without extention of time or employing of pains to collect them, every particular verity bears testimony to any other; so that every one of them is believ'd and works, in the fence and virtue of all. Out of which it is manifest, that every judgment, in such a Separated Soul, hath an infinite strength and efficacy, over any made by an embodied one.

To



To sum all up in a few words. We find three roots of infinity in every action of a Separated Soul, compar'd to one in the Body: First, the freedom of her essence or substance it self: Next, that quality of hers, by which she comprehends place and time; that is, all permanent and successive quantity: and Lastly, the concurrence of infinite knowledges to every action of hers. Having then this measure in our hands, let us apply it to a Well-order'd, and to a Disorder'd Soul, passing out of this world: let us consider the one set, upon those goods, which she shall there have present, and shall fully enjoy; the other, languishing after and pining away for those, which are impossible for her, ever to obtain. What joy, what content, what exultation of mind, in any living man, can be conceiv'd so great, as to be compared with the happiness of one of these Souls? And, what grief, what discontent, what misery can be like the others?

These are the different effects, which the divers manners of living in this world cause in Souls, after they are deliver'd from their Bodies. Out of which and the discourse that hath discover'd these effects to us, we see a clear resolution of that so main and agitated question among the Philosophers, Why a rational Soul is imprison'd in a gross Body of Flesh and Blood? In truth, the question is an illegitimate one; as supposing a false ground: for, the Soul's being in the Body is not an imprisonment, of a thing that was existent before the Soul and Body met together; but her being there is the natural course of beginning that, which can no other way come into the lists of nature. For, should a Soul, by the course of nature, obtain her first being without a Body; either she would, in the first instant of her being, be perfect in knowledg, or she would not: if she were, then would she be a perfect & compleat immaterial substance, not a Soul, whose nature is to be a co-partner to the Body, and to acquire her perfection by the meditation and service of corporeal sense; but if she were not perfect in Science, but were only a capacity thereto, and like white paper in which nothing were yet written, then, unless she were put into a Body, she could never arrive to know any thing, because motion & alteration are effects peculiar to Bodies. Therefore it must be agreed, that she is naturally design'd to begin in a Body. But, her being in a Body is her being one thing with the Body, she is said to be

7.

The reason why Man's Soul requires to be in a Body, and to live for some space of time joy'd with it.



be in. And so she is one part of a whole, which, from its weaker part, is denominated to be a Body.

Again, since the matter of any thing is to be prepared before the end is prepared, for which that matter is to serve; according to that Axiom *Quod est primum in intentione est ultimum in executione*: we may not deny, but that the Body is in being some time before the Soul; or, at least, that it exists as soon as she doth. And therefore, it appears wholly unreasonable, to say, that the Soul was first made out of the Body, and was afterwards thrust into it; since the Body was prepared for the Soul before, or, at least, as soon as she had any beginning. And so we may conclude, that, of necessity, the Soul must be begun, lay'd, hatch'd, and perfected in the Body.

And though it be true, that such Souls as are separated from their Bodies, in the first instant of their being there, are notwithstanding imbued with the knowledg of all things; yet is not their longer abode there in vain: not only, because thereby the *species* is multiplied (for nature is not content with barely doing that, without addition of some good to the Soul it self), as we for the wonderful, and, I may say, infinite advantage, that may thereby accrew to the Soul, if she make right use of it. For, as any act of the abstracted Soul is infinite, in comparison of the acts which men exercise in this life, (according to what we have already shew'd); so by consequence, must any encrease of it be likewise infinite. And therefore we may conclude, that a long life well spent is the greatest and most excellent gift, which nature can bestow on a man.

8.  
That the misery of the Soul in the next world, proceeds out of the inequality not falsity, of her judgments

The unwary reader may perhaps have difficulty, at our often repeating the infelicity of a miserable Soul; since we say, that it proceeds out of the judgments, she had formerly made in this life: which without all doubt, were false ones; and nevertheless, it is evident, that no false judgments can remain in a Soul, after she is separated from her Body (as we have above determined). How then can a Soul's judgments be the cause of her misery? But, the more heedful reader will have noted, that the misery which we put in a Soul proceeds out of the Inequality, not out of the Falsity, of her judgments. For, if a man be inclined to a lesser good, more than to a greater; he will, in action, betake him-



himself to the lesser good, & desert the greater, (wherin, neither judgment is false, nor either inclination is naught) meerly out of the impropotion of the two inclinations or judgments to the ir objects, For, that a Soul may be duely order'd, and in a state of being well, she must have a lesser inclination to a lesser good; and a greater inclination to a greater good. And, in pure Spirits, these inclinations are nothing else, but the strength of their judgments: which judgments in Soul's, while they are in their Bodies, are made by the repetition of more acts, from stronger causes, or in more favourable circumstances. And so it appears how, without any falsity in any judgment, a Soul may become miserable, by her conversation in this world; where all her inclinations generally are good, unless the disproportion of them make them bad.

## CHAP. XII.

*Of the perseverance of a Sou', in the state she finds her self in, at her first separation from her Body.*

**T**HUS we have brought Mans Soul out of the Body she lived in here, & by which she convers'd & had commerce with the other parts of this world; & we have assign'd her her first array and stole, with which she may be seen in the next world: so that now there remains only for us to consider, what shall betide her afterwards, and whether any change may happen to and be made in her, after the first instant of her being a pure Spirit, separated from all consortship with material substances. To determine this point the more clearly, let us call to mind an Axiom which *Aristotle* gives us in his *Logick*. That, As it is true, if the effect be, there is a cause; so likewise 'tis most true, that, if the cause be in act, or causing, the effect must also be. Which Axiom may be understood two ways One, that, if the cause hath its effect, then the effect also is: and this is no great mystery: nor for it are any thanks due to the teacher; it being but a repetition and saying-over-again of the same thing. The other way is, that, if the cause be perfect in the nature of a cause, then the effect is: which is as much as to say, that, if nothing be wanting to the cause, abstracting precisely from the effect; then, neither

I.  
The explication  
& proof of  
that *maxime*.  
that, if the  
cause be in act,  
the effect must  
also be.



is the effect wanting. And this is the meaning of *Aristotle's Axiome*: of the truth & evidence wherof, in this sence, if any man should make the least doubt, it were easie to evince it. As thus, If nothing be wanting but the effect, & yet the effect doth not immediately follow, it must needs be, that it cannot follow at all: for, if it can, and doth not, then something more must be done to make it follow; which is against the supposition, that nothing was wanting; but the effect for, that for which it is to be done, was wanting; To say, it will follow without any change, is senseless: for, if it will follow without change, it follows out of this which is already put: but, if it follow out of this which is precisely put, then it follows against the supposition, which was, that it did not follow, although this were put.

2.  
The effects of  
all such agents  
as work instan-  
taneously are  
compleat in  
the first in-  
stant that the  
agents are  
put.

This then being evident, let us apply it to our purpose: and put three or more things, namely A. B. C. and D; wherof none can work otherwise, than in a instant or indivisibly. And I say, that whatever these four things are able to do, without respect to any other thing besides them, is compleatly done in the first instant of their being put: and, if they remain for all eternity, without communication or respect to any other thing, there shall never be any innovation in any of them, or any further working among them; but they will alwaies remain immutable, in the same state they were in at the very first instant of their being put. For, whatever A, can do in the first instant, is in that first instant actually done: because he works indivisibly: and what can be done precisely by A. & by his action joyned to B. precisely follows out of A. and his action, and out of B. and his action (if B. have any action independent of A). And, because all these are in the same instant, whatever follows precisely out of these and nothing else, that is in the same instant and works indivisibly as they do, is necessarily done in that very instant: but, all the actions of C. & D. & of whatever by reflection from them may be done by A. and B. being all of them indivisible and following precisely out of some of the forenamed actions, follow out of things being in this instant; and, because they are indivisible, they may be in this instant: therefore, all is done in this instant. Now, supposing all to be done, that can be done by them in this instant; and that nothing can follow from them, unless it follow precisely out of what is in this instant; & that it is all indivisible: it



it follows clearly, that whatever (concerning them) is not in this instant, can never be.

These two conclusions being thus demonstrated, let us, in the next place, determine, how all actions of pure Spirits, which have no respect to Bodies, must of necessity be indivisible; that is, must include no continue Succession: by which I mean such a Succession, as may be divided into parts without end. For, if we look well into it, we shall find, that a continue Succession cannot be a thing, which hath in it self a Being; because the essence of such a Succession consists in having some of its parts already past & others of them yet to come: but on the other side, 'tis evident, that no such thing can be, whose essential ingredients are not it self: and therefore it follows evidently, that such a thing, as we call Succession, can have no being in it self; since one essential part of it never is with the other. Therefore, such a Succession must have its being in some permanent thing, which must be divisible; for that is essentially required in Succession: but permanent divisibility is that which we call Bigness or Quantity; from which pure Spirits are free: Wherefore, 'tis most evident, that all their actions, in respect of themselves, are absolutely indivisible.

3.  
All pure Spirits work instantaneously.

Now, to make use of this doctrine to our intent, we say, that, Since our Soul, when it is separated from our Body, is a pure Spirit or Understanding; and that all her actions are indivisible; & that all actions of other Spirits upon her must likewise be such; and by consequence, that there can be no continue succession of action among them: we must of necessity conclude, that, according to the private nature of the Soul, and according to the common notion of spiritual things, there can be no change made in her, after the first instant of her parting from her Body; but, what happiness or misery betides her in that instant continues with her for all eternity. Yet, it is not my mind to say, that, by the course of the universal resolutions (from which she is not wholly exempt) and from supernatural administration of corporeal things, there may not result some change in her. But, the consideration of that matter I remit to those Treatises to which it belongs; as not depending nor ensuing from the particular nature of the Soul; and therefore, not falling under our discussion in this place.

4.  
That a Soul separated from her Body cannot suffer any change, after the first instant of her separation.

This same conclusion may be proved by another argument



ment, besides this which we have now used : and it is this ; What-  
ever works purely by understanding or mind cannot be changed  
in its operations, unless its understanding or mind be alter'd :  
but this cannot happen, unless either it learn somewhat it knew  
not before ; or, forgetting a foreknown truth, it begin after-  
wards to think a fallity. This second part, is impossible, (as  
we have already shew'd, when we prov'd that falshood could  
have no admittance into a Separated Soul) : and the former is as  
impossible, it being likewise proved, that, at her first instant of  
separation, she knows all things. Wherefore, we may hence  
confidently conclude, that no change of mind, (that is no change  
at all) can happen to an Abstracted Soul.

5.  
That tempo-  
ral sins are  
justly punish'd  
with eternal  
pains.

And thus, by discourse, we may arrive, to quit our selves  
easily of that famous objection, so much pestering Christian  
Religion ; How God can, in justice, impose eternal pains upon  
a Soul, for one sin, acted in a short space of time ? For, we see,  
it follows by the necessary course of nature, that, if a man die in  
a disorderly affection to any thing, as to his chief good ; he  
eternally remains, by the necessity of his own nature, in the  
same affection : and there is no imparity, that, to eternal sin,  
there should be imposed eternal punishment.

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CON-

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## C O N C L U S I O N.

**A**Nd now, I hope, I may confidently say, I have been as good as my word : and I doubt not, but my Reader will find it so, if he spend but half as much time in perusing these two Treatises, as the composing them hath cost me. They are too nice (and indeed, unreasonable) who expect to attain without pains, to that, which hath cost others years of toil. Let them remember the words of holy *Job*, that Wisdom is not found in the hand of those that live at their ease. Let them cast their eyes on every side round about them ; and then tell me, if they meet with any employment, that may be compared to the attaining to these and such like principles : wherby a man is enabled to govern himself understandingly and knowingly, towards the happiness, both of the next life and of this ; and to comprehend the Wise-mans theme, What is good for a man in the days of his vanity, whiles he plays the stranger under the Sun. Let us fear Gods judgments. Let us carefully pursue the hidden bounties he hath treasured up for us. Let us thank him for the knowledg he hath given us : and admire the excellency of Christian Religion ; which so plainly teaches us that, to which it is so extreme hard to arrive by natural means. Let us bless him, that we are born to it : and let us sing to him, *that* It is he who preaches his Doctrine to *Jacob*, and gives his Laws to *Israel*. He hath not done the like to all Nations ; nor hath he manifested his secret Truths to them.

**B**Ut, before I cut off this thrid, which hath cost me so much pains to spin out to this Length ; I must crave my Readers leave, to make some use of it for my own behoof. Hitherto my discourse hath been directed to him ; now I shall intreat his patience, that I may reflect it, in a word or two, upon my self. And as I am sure, I have profited my self not a little, by talking all this while to him ; that obliging me to polish my conceptions with more care, and to range them into better order, than while they were but rude meditations within my own brest ; so, I hope, that a little



## CONCLUSION

conversation with my self upon this important subject (which is to be studied for use and practice, not for speculative Science) may prove advantageous to him; if his warmed thoughts have tuned his Soul to such a key, as I am sure these considerations have wound up mine to.

To thee then, my Soul! I now address my speech. For, since, by long debate, and toilsome rowing against the impetuous tides of ignorance and false apprehensions, which overflow the banks and hurry thee headlong down the stream, while thou art imprisoned in thy clayie mansion, we have, with much ado, arrived to aim at some little atome of thy vast greatness; and, with the hard and tough blows of strict and wary reasoning, we have stricken out some few sparks of that glorious light, which inviron and swells thee, or rather, which is thee: 'tis high time, I should retire myself, out of the turbulent and slippery field of eager strife and litigious disputation, to make my accounts with thee; where no outward noise may distract, nor any thing intermeddle between us, excepting only that Eternal Verity, which by thee shines upon my faint and gloomy eys, and in which I see whatever doth or can content thee in me. I have discover'd that thou (my Soul) wilt survive me: and so survive me, as thou wilt also survive the mortality and changes which belong to me; and which are but accidentary to thee, meerly because thou art in me. Then shall the vicissitude of time, and the inequality of dispositions in thee, be turn'd into the constancy of immortality; and into the evenness of one being, never to end, and never to receive a change or succession to better or worse.

When my eye of Contemplation hath been fix'd on this bright Sun, as long as it is able to endure the radiant beams of it; whose redundant light veils the looker on with a dark mist: let me turn it, for a little space, upon the straight passage and narrow gullet, through which thou strivest (my Soul), with faint and weary steps, during thy hazardous voyage upon the earth, to make thy self away. And let me examine, what comparison there is between thy two conditions: the present one, wherein thou now findest thy self immersed in flesh and blood; and the future state that will betide thee, when thou shalt be melted out of this gross oar, and refined from this mean alloy. Let my term of life be of a thousand long years; longer than ever hap'n'd to our aged forefathers: who stored the earth with their numerous progeny,



## C O N C L U S I O N.

121

progeny, by out-living their skill to number the diffused multitudes that swarm'd from their loins. Let me, during this long space, be sole Emperor and absolute Lord of all the huge globe of land and water, compassed with *Adam's* offspring. Let all my subjects ly prostrate at my feet, with obedience and awe; distilling their active thoughts, in studying day and night to invent new pleasures and delight for me. Let Nature conspire with them, to give me a constant and vigorous health; a perpetual spring of Youth, that may to the full, relish whatever good, all they can fancy. Let gravest Prelates and greatest Princes, serve instead of flatterers to highten my joys; and yet those joys be rais'd above their power of flattery. Let the Wisdom of this vast Family (whose sentiments are maxims and oracles, to govern the worlds beliefs and actions) esteem, reverence, and adore me in the secretest and most recluse withdrawings of their hearts. Let all the Wealth, which to this very day, hath ever been torn out of the bowels of the Earth, and all the Treasures, which the Sea hides from the view of greedy men, swell round about me: whilst all the world besides, lyes gaping, to receive the crumbs, that fall neglected by me from my full loaden table. Let my imagination be as vast, as the unfathomed Universe; and my felicity as accomplish'd, as my imagination can reach to: so that, wallowing in pleasure, I be not able to think how to increase it; or what to wish for more, than that which I possess and enjoy.

Thus, when my thoughts are at a stand, & can raise my present happiness no higher; let me call to mind, how, this long Lease of pleasant dayes will in time come to an end, this bottom of a thousand joyful years will at length be unwound, and nothing remain of it: and then (my Soul) thy infinitely-longer-lived Immortality will succeed, thy never ending date will begin a new account; impossible to be sum'd up, and beyond all proportion, infinitely exceeding the happiness we have rudely aim'd to express, so that no comparison can be admitted between them. For, suppose, First, that such it were, as the least and shortest of those manifold joys, which swell it to that height we have fancy'd, were equal to all the contentment thou shouldst enjoy in a whole million of years: yet millions of years may be so often multiply'd, as, at length, the slender and limited contentments supposed in them may equalize and outgo the whole heap of overflowing bliss,



rais'd so high in the large extent of these thousand happy years. Which when they are cast into a total sum; and I compare it with the unmeasurable Eternity, which only measures thee: then I see, that all this huge product of Algebraical multiplication appears as nothing, in respect of thy remaining and never-ending survivance; & is less, than the least point in regard of the immense Universe. But then, if it be true (as it is most true) that thy least spark and moment of real happiness, in that blessed Eternity thou hopest for, is infinitely greater and nobler, than the whole mass of fancied joys, of my thousand years life here on earth: how infinitely wil the value of thy duration exceed all proportion, in regard of the felicity I had imagined my self? And, seeing there is no proportion between them; let me sadly reflect on my own present condition: let me examine what it is, I so busily and anxiously employ my thoughts and precious time upon: let me consider my own courses, and whither they lead me: let me take a survey of the lives and actions of the greatest part of the world, which make so loud a noise about my ears. And then may I justly sigh out, from the bottom of my anguished heart, To what purpose have I hitherto lived? To what purpose are all these millions of toilsome Ants, that live and labour about me? To what purpose were *Cæsar's* and *Alexander's*? To what purpose *Aristotle's* and *Archimedes's*? How miserably foolish are those conquering Tyrants, that divide the world with their lawless Swords? What senseless Idiots those acute Philosophers, who tear mens wits in pieces by their different ways and subtle Logick: striving to shew men *Beatitudes* in This World; & seeking for that, which, if they had found, were but a nothing of a nothing in respect of true *Beatitude*? He only is wise, who, neglecting all that flesh & blood desires, endeavors to purchase at any rate This Felicity, which Thy survivance promises: the least degree of which so far surmounts all the heaps which the Giants of the earth are able to raise; by throwing hills on hills, and striving in vain to scale and reach those eternities, which reside above the Skies. Alas, how fondly doth mankind suffer it self to be deluded? How true it is, that the only thing necessary proves the only that is neglected? Look up, my Soul, and fix thine eye upon that truth, which eternal light makes so clear to thee; shining upon thy face with so great evidence, as defies the noon-tide Sun, in its greatest brightness.

Am



## C O N C L U S I O N.

12

And this it is, that every action of thine, be it never so slight, is mainly mischievous, or, be it never so bedeckt with those specious considerations which the wise men of the world judg important, is foolish, absurd, and unworthy of a man, unworthy of one that understands and acknowledges thy dignity; if in it there be any speck, or through it there appear any spark of those mean and flat motives, which, with a false byas, draw any way aside, from attaining that happiness, we expect in thee. That happiness ought to be the end and mark we level at: that, the rule and model of all our actions: that, the measure of every circumstance, of every atome, of whatever we bestow so precious a thing upon, as the employment of thee is.

But, we must not so slightly pass over the intenseness and vehemence of that Felicity which thou (my Soul) shalt injoy, when thou art sever'd from thy benumbing compartner. I see evidently, that thou dost not survive a simple & dull essence; but art replenish'd with a vast & incomprehensible extent of riches & delight within thy self. I see that golden chain, which here by long discourses fills huge volumes of Books, and dives into the Hidden natures of several Bodies: all in thee resumed into one circle or link, which contains in it self the large scope of whatever screwing discourse can reach to. I see it comprehend and master the whole world of Bodies. I see every particular nature, as it were imbossed out to the life, in thy celestial garment. I see every solitary substance rank'd in its due place and order; not crush'd or throng'd by the multitude of its fellows: but each of them in its full extent, in the full propriety of every part and effect of it; and distinguish'd into more divisions, than ever nature sever'd it into. In thee I see an infinite multitude enjoy place enough. I see, that neither height, nor profundity, nor longitude, nor latitude, are able to exempt themselves from thy diffused powers: they fathom all, they comprehend all, they master all, they enrich thee with the stock of all; and thou thy self art all, and somewhat more than all, and yet now but one of all. I see, that every one of this all in thee encreases the strength, by which thou know'st any other of the same all: & all encreases the knowledge of all, by a multiplication beyond the skill of Arithmetick; being (in its kind) absolutely infinite, by having a nature incapable of being either infinite or finite. I see again, that those



things which have not knowledg are situated in the lowest and meanest rank of creatures ; and are in no wise comparable to those which know. I see, there is no pleasure at all, no happiness, no felicity, but by and in knowledg. Experience teaches me, how the purer and nobler race of mankind adores in their hearts this idol of knowledg, and scorns whatever else they seem to court and be fond of. And I see, that this excess or Sea of knowledg, which is in thee, grows not by the succession of one thought after another : but it is like a full swoln Ocean, never ebing on any coast, but equally pushing at all its bounds, and tumbling out its flowing waves on every side, and into every creek ; so that every where it makes high tide. Or like a pure Sun, which from all parts of it shoots its radiant beams, with a like extremity of violence. And I see likewise, that this admirable knowledg is not begotten and conserv'd in thee by the accidental help of defective causes, but rooted in thy self, and steep'd in thy own essence ; like an unextinguishable source of a perpetual streaming fire, or the living head of an everrunning spring : beholding to none, out of thy self, save only to thy Almighty Creator, and begging of none ; but being in thy self all that of which thou should'st beg.

This then (my Soul) being thy lot, and such a height of pleasure being reserv'd for thee, such an extremity of felicity within a short space attending thee : can any degenerate thought ever gain strength enough, to shake the evidence which these considerations implant and rivet in thee ? Can any dull oblivion deface this so lively and so beautiful image ; or any length of time draw in thy memory a veil between it and thy present attention ? Can any perversity so distort thy straight eyes, that thou should'st not look alwaies fix'd on this Mark, and level thy aim directly at this White ? How is it possible that thou canst brook to live, and not expire presently ; thereby to ingulf thy self, and be thoroughly imbibed with such an overflowing blis ? Why dost thou not break the walls and chains of thy flesh and blood ; and leap into this glorious liberty ? Here, Stoicks, you are to use your swords. Upon these considerations, you may justifie the letting out the blood, which, by your discourses, you seem so prodigal of. To die upon these terms is not to part with that, which you fondly call happy life ; feeding your selv's, and flattering your hearts



## CONCLUSION.

125

hearts with empty words : but rather it is, to plunge your selves into a felicity, you were never able to imagine or frame to your misguided thoughts any scantling of.

But, nature pulls me by the ear; and warns me from being so wrongful to her, as to conceive that so wise a governess should, to no advantage, condemn mankind to so long a banishment, as the ordinary extent of his dull life & wearisom pilgrimage here under the Sun reaches to. Can we imagine, she would allow him so much lazy time, to effect nothing in? Or can we suspect she intends him no further advantage, than what an abortive child arrives to in his mothers womb? For, whatever the nets and toils of discourse can circle in; all that he, who but once knows that himself is, can attain to as fully, as he that is enrich'd with the Science of all things in the world. For, the connexion of things is so linked together, that, proceeding from any one, you reach the knowledg of many; and from many, you cannot fail of attaining all. So that a Separated Soul, which but knows her self, cannot choose but know her Body too; and from her Body, she cannot miss in proceeding from the causes of them both, as far as immediate causes proceed from others over them: and as little can she be ignorant, of all the effects of those causes she reaches to. And thus, all that huge masse of knowleg and happiness, which we have consider'd in our last reflection, amounts to no more, than the silliest Soul buried in warm blood can and will infallibly attain to, when its time comes. We may then assure our selves, that just nature hath provided and design'd a greater measure of such felicity for longer lives: and so much greater, as may well be worth the pains and hazzards of so miserable and tedious a passage, as here (my Soul) thou strugglest through. For, certainly, if the dull percussion, which, by natures institution, hammers out a spiritual Soul from gross flesh and blood, can atchieve so wondrous an effect, by such blunt instruments as are used in the contriving of a man: how can it be imagined, but that 50 or an 100 years beating upon far more subtle elements, refined in so long a time, as a child is becoming a man & arriving to his perfect discourse, must necessarily forge out in such a Soul a strange and admirable excellency, above the unlick'd form of an abortive *Embryon*? Surely, those innumerable strokes (every one of which makes a strong impression in the Soul,

upon



upon whom they beat) cannot choose but work a mighty difference in the subject that receives them; changing it strangely from the condition it was in, before they begun to new mould it. What if I should say, the odds between two such Souls may, peradventure, be not unlike the difference, between the two wits & judgments of the subtlest Philosopher that ever was, and of the dullest Child or Idiot living. But this comparison falls too short by far: even so much, that there is no resemblance or proportion between the things compared. For, as the excess of great numbers one to another drowns the excess of small ones, and makes it not considerable in respect of theirs, though they should be in the same proportion: so, the advantages of a Soul forged to its highest perfection in a mans Body, by its long abode there and making right use of that precious time allow'd it, must needs (in positive value, though not in geometrical proportion) infinitely exceed, when it shall be deliver'd out of prison, the advantages which the newly hatcht Soul of an abortive infant shall acquire at the breaking of its chains. In this case, I believe, no man would be of *Cæsar's* mind; when he wished to be rather the first man in a contemptible poor *Village*, he passed through among the desert mountains, than the second man in *Rome*. Let us suppose the wealth of the richest man, in that barren habitation, to be one hundred Crowns, and that the next to him in substance had but half so much as he; in like manner, in that opulent City, the head of the world (where millions were as familiar as pence in other places) let the excess of the richest mans wealth be but (as in the former) double over his that comes next him: and there you shall find, that if the poorest of the two be worth fifty millions, the other hath fifty millions more than he: whereas the formers petty treasure exceeds his neighbours but by fifty Crowns. What proportion is there, in the common estimation of affairs, between that trivial sum and fifty millions? Much less is there, between the excellency of a Separated Soul, first perfected in its Body; and another that is let loose into compleat liberty, before its Body arrived, in a natural course, to be deliver'd into this world, and by its eye to enjoy the light of it. The change of every Soul, at its separation from the Body, to a degree of perfection, above what it enjoy'd in the Body, is in a manner infinite; and, by a like infinite proportion, every degree of



of perfection it had in the Body is also then multiply'd : what a vast product, then, of infinity must necessarily be raised, by this multiplying instant of the Souls attaining liberty, in a well-moulded Soul ; infinitely beyond that perfection, which the Soul of an Infant, dying before it be born, arrives to ? And yet we have determin'd that to be, in a manner, infinite. Here our skill of Arithmetick and proportion fails us. Here we find infinite excess, over what we also know to be infinite. How this can be, the feeble eyes of our limited understanding are too dull to penetrate into : but, that it is so, we are sure ; the rigor of discourse convinces & necessarily concludes it. That assures us, that, since every impression upon the Soul, while it is in its Body, makes a change in it ; were there no others made, but meerly the iterating of those acts which brought it from ignorance to knowledg, that Soul, upon which a hundred of those acts had wrought, must have a hundred degrees of advantage over another, upon which only one had beaten : though, by that one, it acquired perfect knowledg of that thing. And then, in the separation, these hundred degrees being each of them infinitely multiply'd, how infinitely must such a Soul exceed, in that particular (though we know not how) the knowledg of the other Soul ; which, though it be perfect in its kind, yet had but one act to forge it out ? When we arrive to understand the difference of knowledg, between the superior and inferior ranks of *Intelligences* ; among whom, the lowest knows as much as the highest, and yet the knowledg of the highest is infinitely more perfect and admirable than the knowledg of his inferiors : then, & not before, we shall thoroughly comprehend this mystery. In the mean time, 'tis enough for us, that we are sure thus it fares with Souls : and that, by how much the excellency and perfection of an all-knowing and all-comprehending Soul, deliver'd out of the Body of a wretched Embryon, is above the vileness of that heavy lump of flesh, it lately quitted in its mothers womb ; even by so much, and according to the same proportion, must the excellency of a compleat Soul (compleat in its Body) be in a pitch above the adorable majesty, wisdom, and augustness, of the greatest and most admired oracle in the world, living embodied in flesh and blood. Which as it is in a height and eminency over such an excellent and admirable man, infinitely beyond the excess of such a man, over that silly lump of flesh which composes the most contemptible

Idiot



Idiot or Embryon : so, likewise, is the excess of it, over the Soul of an abortive Embryon, (though by the separation grown never so knowing and perfect) infinitely greater than the dignity and wisdom of such a man is above the feebleness and misery of a new animated child. Therefore have patience, my Soul ! repine not at thy longer stay here in this veil of misery, where thou art banish'd from those unspeakable joys thou seest at hand before thee. Thou shalt have an overflowing reward, for thy enduring and patienting in this thy darksome prison. Deprive not thy self, through mischievous hast, of the great hopes and admirable felicity that attend thee; canst thou but with due temper stay for it. Be content to let thy stock lye out a while at interest; thy profits will come in, in vast proportions: every year, every day, every hour, will pay thee interest upon interest; and, the longer it runs on, the more it multiplies. And by the account thou shalt find (if thou proceedest as thou should'st) that one moment oft-times brings in a greater increase to thy stock of treasure, than the many years thou didst live and trade before: and, the longer thou livest, the thicker will these moments arrive to thee. In like manner as in Arithmetical Numeration, every addition of the least Figure multiplies the whole sum it finds. Here thou wilt prove how true that rich man said, who of his gains pronounced, that he had gotten little with great labor, and great sums with little: So, if thou bestow'st well thy time, thy latter sums will bring thee in huge accounts of gain, upon small expence of pains or employment; whereas thy first beginnings are toilsome and full of pain, and bring in but slender profit.

By this time, my Soul, I am sure thou art satisfied, that the excess of knowledg & pleasure, which thou shalt enjoy, is vastly beyond any thou art capable of here. But, how may we esteem the just proportion they have to one another? Or rather, is not the pleasure of a Separated Soul so infinitely beyond all that can be relish'd by one embodied here in clay, that there is no proportion between them? At least, though we are not able to measure the one, let us do our best to aim and guess at the improportion between them: and rejoyce that we find it beyond our reach to conceive or imagine any thing, nigh the truth and huge excess of thy good (my Soul) over the most I am capable of in this world. 'Tis agreed, that the vehemence and intensness of any pleasure is proportionable to the activity, power, & energy of the subject, which

is



## CONCLUSION.

119

is affected with such pleasure : and to the gravitation bent, and pressure such a subject hath to the object that delights it. Now, to rove at the force and activity, wherewith a Separated Soul weighs and strives to joyn it self to what its nature carries it to; let us begin with considering the proportion of celerity and forcibleness wherwhith heavy bodies move downwards. I see, a pound weight, in one scale of the Ballance, weighs up the other empty one with great celerity : But, if into that you imagine a million of pounds to be put; you may well conceive, that this great excess would carry up the single pound weight with so much violence and speed, as would hardly afford your eye liberty to observe the velocity of the motion. Let me multiply this million of pounds by the whole globe of the Earth; by the vast extent of the great Orb, made by the Sun's or Earth's motion about the center of the World: by the incomprehensibility of that immense storehouse of matter and of bodies, which is design'd in lump by the name of the *Universe*; of which we know no more, but that it is beyond all hope of being known, during this mortal life. Thus when I have heap'd together a bulk of weight, equal to this unweildy machine; let me multiply the strength of its velocity and pressure, over the least atome imaginable in nature, as far beyond the limits of gravity, as the ingenious skil wherwhith *Archimedes* numbred the least grains of sand that would fill the world, can carry it. And when I have thus wearied my self, and exhausted the power of *Arithmetick*, and of *Algebra*, I find there is still a proportion betweent hat atome and this unutterable weight; I see it is all quantitative, all finite & all this excess vanishes to nothing & becomes invisible (like twinkling Stars, at the rising of the much brighter Sun, ) as soon as the lowest and meanest Substance shines out of that orb, where they reside that scorn divisibility, and are out of the reach of quantity and matter. How vehement then must the activity and energy be, wherewith so puissant a Substance shoots itself to its desired object? and, when it injoyes it, how violent must the extasie and transport be, wherwith it is delighted? How is it possible then for my narrow heart, to frame an apprehension of the infinite excess of thy pleasure (my Soul) over all the pleasure this limited world can afford; which is all measured by such petty proportions. How should I stamp a figure of thy immense greatness,



## CONCLUSION.

ness, into my material imagination? Here I loose my power of speaking, because I have too much to speak of: I must become silent and dumb, because all the words and language I can use express not the thousandth, nor the millionth, part, of what I evidently see to be true. All I can say is, that whatever I think or imagine is not That: and that it is not like any of those things; to some of which unless it be like, 'tis impossible for me to make any proportion or similitude to it. What then shall I do, but lay my self down in mine own shadow; and there rejoyce that Thou art a light so great, as I am not able to endure the dazzling splendor of thy rays: that thy pleasure is so excessive, as no part of it can enter into my circumscribed heart; without dilating it so wide, that it must break in sunder: and that thy happiness is so infinite, as the highest pitch I can hope for to glut my self with, during this dark night of my tedious pilgrimage here on earth, is to see evidently, that it is impossible for me, in this life to frame any scantling of it; much less, to know how great it is. Shall I then once again presume to breake out into impatience, at my delay of so great blifs; and cry out, that I am content with the meanest share of this exuberant felicity? I care not for the exaggerations which a longer life may heap up to it. I am sure here is sufficient to swell my heart beyond it self, to satisfy my thirsty Soul, to dissolve and melt all my powers, and to transform me totally into a self-blessed creature. Away, away all tedious hopes, not only in this life, but even of all increase in the next. I will leap boldly into that fountain of Blifs, and cast my self headlong into that sea of Felicity; where I can neither apprehend shallow waters, nor fear I shall be so immers'd and drown'd, as to meet with any shelf or dry ground, to moderate and stint my happiness. A self-activity, an unbounded extent, an essence free from time and place, assure me sufficiently that I need desire no more. Which way soever I look, I lose my sight, in seeing an infinity round about me. Length without points: Breadth without Lines: Depth without any surface. All content, all pleasure, all restless rest: all an unquietness and transport of delight, all an extasie of fruition.

Happy forgetfulness, how deeply am I obliged to thee, for making room for this Soul-ravishing contemplation; by removing this, while all other images of things be far from me? I would to God thou might'st endure, whiles I endure; that so I might be  
drown'd



drown'd in this present thought, and never wake again, but into the enjoying and accomplishment of my present enflamed desires. But alas, that may not be. The eternal light, whom my Soul and I have chosen for Arbiter, to determine to us what is most expedient for us, will not permit it. We must return; and that into fears and miseries: For, as a good life breeds encrease of happiness, so doth an evil one heap up Iliads of wo. First (my Soul), before I venture, we should be certain, that thy parting from this life waft thee over to assured happiness. For, thou well know'st, that there are noxious actions; which deprave & infect the Soul, while it is forging and moulding here in its Body, and tempering for its future Being: and, if thou should'st sally hence in such a perversè disposition, unhappiness would betide thee instead of thy presumed Bliss. I see some men so ravenous after those pleasures, which cannot be enjoy'd out of the Body, that, if those impotent desires accompany their Souls into Eternity, I cannot doubt of their enduring an eternity of Misery: I cannot doubt of their being tormented with such a dire extremity of unsatisfiable desire and violent grief, as were able to tear all this world into pieces, were it converted into one heart; and to rive in sunder any thing less than the necessity of contradiction. How high the Bliss of a well-govern'd Soul is above all power of quantity, so extreme must be the ravenous inclemency and Vulture-like cruelty of such an uncompassable desire gnawing eternally upon the Soul; for the same reason holds in both: and, which way soever the gravitation and desires of a Separated Soul carry it, it is hurried on with a like impetuosity and unlimited activity. Let me then cast a heedful and wary eye on the actions of the generality of mankind; from whence I may guess at the weal or wo of their future state: and, if I find that the greatest number weighs down in the scale of misery, have I not reason to fear lest my lot should prove among theirs? For, the greatest part sweeps along with it every particular, that hath not some particular reason to exempt it from the general law. Instead, then, of a few, that wisely settle their hearts on legitimate desires; what multitudes of wretched men do I see: some hungry after Flesh and Blood, others gaping after the empty wind of Honour and Vanity, others breathing nothing but Ambitious thoughts, others grasping all and grov'ling upon heaps of melted Earth? So  
that



## CONCLUSION

that they put me all in a horror; and make me fear, lest very few they be, that are exempted from the dreadful fate of this incomprehensible misery, to which I see, and grieve to see, the whole face of mankind desperately turned. May it not then be my sad chance, to be one of their unhappy number? Be content then, fond man, to live. Live yet, till thou hast first secured the passage which thou art but once to venture on. Be sure, before thou throwst thy self into it, to put thy Soul into the Scales: ballance all thy thoughts, examine all thy inclinations, put thy self to the test, try what dross, what pure gold is in thy self; and what thou findest wanting, be sure to supply, before nature calls thee to thy dreadful account. 'Tis soon done, if thou beest what thy nature dictates thee to be. Follow but evident reason and knowledg; and thy wants are supply'd, thy accounts made up. The same evershining truth, which makes thee see that two and two are four, will shew thee, without any contradiction, how all these base allurements are vain and idle: and that there is no comparison between the highest of them, and the meanest of what thou maist hope for; hast thou but strength to settle thy heart by the steerage of this most evident Science. In this very moment thou maist be secure: But, the hazard is great, in missing to examine thy self truly and thoroughly: And, if thou miscarry there, thou art lost for ever. Apply therefore all thy care, all thy industry to that: Let that be thy continual study, and thy perpetual entertainment: Think nothing else worth the knowing, nothing else worth the doing; but screwing up thy Soul to this height, but directing it by this level, by this rule. Then fear not, nor admit the least doubt of thy being happy, when thy time shall come; and that time shall have no more power over thee. In the mean season, spare no pains, forbear no diligence, employ all exactness: burn in Summer, freeze in Winter, watch by night, & labour by day; joyn months to months, entail years upon years. Think nothing sufficient to prevent so main a hazard; and deem nothing long or tedious in this life, to purchase so happy an Eternity. The first discoverers of the *Indies* cast themselves among swarms of Man-eaters; they fought and struggled with unknown ways: so horrid ones, that often times they perswaded themselves they climb'd up mountains of waters, and straight again were precipitated headlong



headlong down between the cloven sea, upon the foaming sand, from whence they could not hope for a resource. Hunger was their food, Snakes, and Serpents were their dainties; sword and fire were their daily exercise: and all this, only to be masters of a little Gold, which after a short possession, was to quit them for ever. Our searchers after the *Northern passage* have cut their way through mountains of ice, more affrightful and horrible, than the *Simplegades*. They have imprison'd themselves in half-year nights; they have chain'd themselves up in perpetual stone-cleaving colds: some have been found closely embracing one another, to conserve, as long as they were able, a little fewell in their freezing hearts; at length petrefy'd by the hardness of that unmerciful winter. Others have been made the prey of inhumane men more savage, than the wildest Beasts: others have been never found nor heard of; so that surely they have proved the food of ugly monsters of that vast icy Sea. And these have been able and understanding men. What motives, what hopes had these daring men? What gains could they promise themselves, to countervail their desperate attempts? They aim'd not so much as at the purchase of any treasure for themselves; but meerly to second the desires of those that set them on work, or to fill the mouths of others, from whence some few crumes might fall to them. What is required at thy hands (my Soul) like this? And yet the hazard thou art to avoid, and the wealth thou art to attain, incomparably over-sets all that they could hope for. Live then, and be glad of long and numerous years: that, like ripe fruit, thou maiest drop securely into that passage; which duely entred into, shall deliver thee into an eternity of Bliss and unperishable happiness.

And yet (my Soul) be thou not too sore agast, with the apprehension of the dreadful hazard thou art in. Let not a tormenting fear of the dangers that surround thee make thy whole life here bitter and uncomfortable unto thee. Let the serious and due consideration of them arm thee with caution and wisdom to prevent miscarriage by them: But, to look upon them with horror and affrightedness would freez thy spirits, and benum thy actions; and peradventure engulf thee, through,

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pusillanimity, in as great mischiefs, as thou seekest to avoid. 'Tis true, the harm, which would accrue from misgoverning thy passage out of this life, is unspeakable, is unimaginable: But, why shouldst thou take so deep thoughts of the hazard thou runst therein; as though the difficulty, of avoiding it were so extream; as might amount to an impossibility? I allow, the thoughts, that arm thee with wise caution to secure thy self, cannot be too deep nor too serious; but, when thou hast providently stored thy self with such, call thy spirits manfully about thee. And, to encourage thee to fight confidently, or rather to secure thee of victory, so thou wilt not forsake thy self, turn thine eyes round about thee; and consider how wise Nature, that hath prescribed an end and period to all her Plants, hath furnish'd them all with due and orderly means to attain therto: and, though particulars sometimes miscarry in their journey (since contingency is entayl'd to all created things), yet in the generality, and for the most part, they all arrive to the scope she levels them at. Why then should we imagine, that so judicious and far-looking an Architect, whom we see so accurate in his meaner works, should have framed this masterpiece of the world, to perish by the way: & never to attain that great end, for which he made it; even after 'tis prepared and arm'd with all advantageous circumstances agreeable to its nature. That Artificer, we know, deserves the stile of silly, who frames such tools, as fail in their performance, when they are appli'd to the action for which they were intended. We see all sorts of Trees, for the most part, bear their fruit, in due season; which is the end they are design'd to, and the last and highest emolument they are made to afford us. Few Beasts, we see, there are, but contribute to our service what we look for from them. The Swine affords good flesh, the Sheep good wool, the Cow good milk, the Sable warm and soft fur; the Ox bends his sturdy neck to the yoke, the spiritfull Horse dutifully bears the Souldier, and the sinewy Mule and stronger Camel Convey weighty merchandise. Why, then, shal even the better sort of Mankind, the chief, the top, the head of all the works of Nature, be apprehended to miscarry from his end; in so vast a proportion, as that it should be deem'd in a manner impossible, even for those few (for so they are, in



## C O N C L U S I O N.

138

in respect of the other numerous multitude of the worser sort) to attain to that felicity which is natural to them? Thou (my Soul) art the form, and that supream part of me, which gives being both to me and to my body: who then can doubt, but that all the rest of me is framed fitting and serviceable for thee? For, what reason were there, that thou should'st be implanted in a soil which cannot bear thy fruit? The form of a Hog, I see, is engrafted in a body fit and appropriated for a Swines operations: the form of a Horse, of a Lion, of a Wolf, all of them have their organs proportioned to the mastering piece within them; their Soul. And is it credible that only Man should have his inferiour parts rais'd so highly in rebellion against his Soul, the greatest Mistress (beyond proportion) among all forms: as that it shall be impossible for her to suppress their mutinies, though she guide her self never so exactly by the prescripts of that rule, which is born with her? Can it be suspected, that his form, which is infinitely mounted above the power of Matter, should, through the very necessity and principles of its own nature, be more liable to contingency, than those that are engulfed and drown'd in It? since, we know, that contingency, defectibility, and change, are the children of gross and misshapen matter.

Alas, it is too true, that nature is in us unhappily wrested from her original and due course. We find by sad experience, that, although her depravation be not so total, as to blind entirely the eye of *Reason* she sees by; yet it is so great, as to carry vehemently our affections quite cross to what she proposes us as *Best*. However, let the Incentives of flesh & blood be never so violent, to tumble humane nature down the hill; yet, if a contrary force, more efficacious, than they with all their turbulent & misty steams, impel it another way, it must needs obey that stronger power. Let us then examine whose motives the Soul's or the Sense's, in their own nature, work most efficaciously in Man. We are sure, that what pleasure he receives, he receives by means of his Soul; even all corporal pleasure: for, be the working object never so agreeable and pleasing to him, he reaps thence smal delight, if, in the mean time, his Soul's attention be carried another way from it. Certainly then, those things



must affect the Soul most powerfully, which are connatural to her; and which she seises on and relishes immediately: rather those impure ones, which come sophisticated to her, through the muddy channels of the Senses. And accordingly, all experience teaches us, that her pleasures, when they are fully favored, are much stronger, than the pleasures of our Senses. Observe but the different comportments of an Ambitious, and of a Sensual man: and you will evidently perceive far stronger motions, and more vehement strains, in the former, who hath his desires bent to the satisfaction of his Mind; than in the other, who aymes but at the pleasures of his Body. Let us look upon the common face of mankind; and we shall see the most illustrious and noble part taken with Learning, with Power, with Honour; and the other part which makes Sense their Idol, moves in a lower and baser orbe under the others, & is in a servile degree to them. Since then humane nature is of it self more inclined to the contentments of the active mind, than of the dull sense: who can doubt, but that the way of those pure contentments must be far sweeter, than the gross and troubled streams of sensual pleasures? Which if it be, certainly man, in his own nature, is more apt to follow that; and when he chances to wander out of that smooth and easie road, his steps are painful and wearisome ones: and, if he do not presently perceive them such, it is, because it fares with him, as with those that walk in their sleep, and stray into rough and stony passages, or among thistles and briars, whiles, peradventure, some illuding dream bewitches their fancies, and perswades them they are in some pleasant garden; till waking, (if, at least, they wake before they fall into a deadly precipice) they find their feet all gored, and their bodies all scratch'd and torn. If any sensual man should doubt of this great truth, and find it hard to perswade himself, that intellectual pleasures (which, to his depraved taste, seem cold and flat ones) should be more active and intense, than those feculent ones, which so violently transport him: let him but exercise himself a while in those entertainments which delight the mind, taking leave, during that space, of those unruly ones which agitate the body; and continue doing thus, till, by long practice, he hath made them



them easie, and babituated himself to them. And, I will engage my word, that he will find this change so advantageous to him, even in contentment and delights; that he will not easily be brought back to his former course of life. Experience shews us, that whatever is long customary to us turns into our nature: so much that even diseases and poisons, by diurne use, mould and temper to themselves those bodies which are habituated to them; in such sort, that those pests of nature must be kept on foot, and fed on for our sustenance. How much more then, must the most connatural exercise of mental pleasure turn so substantially into our being, that, after some good practice in it, we shall not be able, without great struggling and reluctance, to live without it.

The violence of fruition in those foul puddles of flesh and bloud presently gluts with satiety, and is attended with annoy and dislike: and the often using and repeating it, wears away that edg of pleasure, which only makes it sweet and valuable, even to them that set their hearts on it; and nothing heightens it, but an irritation by a convenient hunger and abstinence. Contrarywise, in the Soul, the greater and more violent the pleasure is, the more intense and vehement the fruition is: and, the oftner it is repeated, so much the greater appetite and desire we have to return to the same; and nothing provokes us more, than the entire and absolute fruition of it. If a suddain change, from one extreame of flesh and bloud, to the other opposite pole of spiritual delights and entertainments, seem harsh to him, whose thoughts, by long assuefaction, are glew'd to corporal objects; let him begin with gently bridling in his inferior motions under a fair rule of government: If he cannot presently suppress and totally mortifie their clamorous desires, let him at least moderate and steer them according to the bent of reason. If we wil but follow this course which nature teaches us, to heighten even our sensual delights and pleasures, by reasonable moderation of them to their own advantage; we shall find her so kind a mother to us, that of her self she will at length quell and disencumber us of all our enemies. If we but temperately attend her work, she will quietly waft us over to our desired end, to our beloved happiness. In a few years,



## CONCLUSION.

by boyling away our unruly heat, she will abate, and in the end, quite wear away the sense of those transporting pleasures, we used to take so much delight in the fruition of. Within a while, rheums will so clog our tongue and palates, that we shall but flatly relish the most poynt meates. Our dul'd ear's will no longer devour with delight the ravishing sound of sweet harmonies. Our dim eyes will carry to our heavy fanſie, but confused news of any beautiful and pleasing objects. Our stopp'd noſethrils will afford no paſſage for ſpiritual perfumes, to warn and recreate our moiſt and drowſie brain. In a word, nature will ere long, warn us to take a long farewel of all thoſe contentments and delights, which require a ſtrong, vigorous & athletike habite of body to enjoy. She will ſhew us, by ſetting our graves before our eyes, how vain this glittering fanſie of Honour is: how unprofitable the ſtaff of Power, to underprop our falling being: how more burthenſome than helpful are thoſe maſſie heaps of Gold and Silver, which when we have, the greateſt uſe we make of them is but to look on them and court them with our dazled eyes; while they encompass us with armies of traytors and hungry wolves, to teare them from us, and us in pieces for their ſake. Thus will nature of her ſelf, in a ſhort time, dul l thoſe weapons that offend us; and deſtroy the enemies of thoſe verities that ſhine upon us. Courage then, my Soule; and neither fear to live, nor yet deſire to die. If thou continuelt in thy Body, 'tis eaſie for thee, and ſweet and contentſome, to heap up treaſures for Eternity: And, if thou partelt from it, thy hopes are great and fair, that the journey thou art going is to a world of unknown felicity. Take heart then, and march on with a ſecure diligence and expect the hand of bounteous nature, to diſpoſe of thee, according as ſhe hath wiſely and benignly provided for thee. And fear not but that, if thou haſt kept a reaſonable amity with her, ſhe will paſs thee to where thou ſhalt never more be in danger of jaring with her; nor of feeling within thy ſelf the unkind blows of contrary powers fighting in thee, whiles thou bleedeſt with the wounds that each ſide gives: nor of changing thy once gain'd happineſs into a contrary condition, according to the viciffitudes of all humane affairs; But ſhall for ever be ſwell'd, to the utmoſt extent.



## CONCLUSION.

130

tent of thy infinite nature, with this torrent, with this abyss of joy, pleasure, and delight.

But here ( my Soul ) well maist thou stand amazed at this great word, For ever. What will this be, when fleeting time shall be converted into permanent Eternity? Sharpen thy sight to look into this vast profundity. Suppose that half an hour were resumed into one instant or indivisible of time : what a strange kind of durance would that be? I see, that half an hour is divisible without end, into halves, and halves of halves, and quarters of quarters; and, after myriads of divisions, no parcel is so little, but that it hath an infinite superproportion to an indivisible instant. What a prodigious thing, then, must it be, to have an instant equalise half an hour? Were it but some ordinary notion or *quiddity* (as, of magnitude, of place, of activity, or the like), in which this excellency, of an indivisibles equalizing a large extent, were consider'd; my fantasie would offer to wrestle with it : and peradventure, by strong abstraction, and deep retirement into the Closet of Judgment, I might hazard to frame some likeness of it. But, that, wherein this multiplication is, is the noblest, the highest, and the root of all other notions; it is Being and Existence it self. I my self, while I am, have my existence determined but to one poor instant of time; and, beyond, that I am assured of nothing. My slender thred of Being may break, I still find it may break asunder, as near to that instant, as I can suppose any thing to be near it: and when I shall have supposed Here, it may break nearer and nearer; and I can never arrive to settle the nearest point where it may snap in two. But when time shall be no more; or at least, shall, in respect of me, be turn'd into Eternity : this, this frail Existence of mine, will be stretch'd out beyond the extent of all-conquering time. What strange thing, then is this admirable multiplication of Existence: or how may I be able to comprehend it? Existence is that which comprehends all things: and, if God be not comprehended in it, thereby it is, that he is incomprehensible of us; and he is not comprehended in it, because himself is it. He is existence: and, by



being so, he equals, not comprehends it. From hence, then, I may gather the excellency and vast empire of Existence, in its own nature : and so conclude, how admirable a change and betterment that must be, which encreases and multiplies so infinitely the existence I now enjoy. For, be it never so specious, be it never so glorious, be it what it is, *Existence*, the top, the flower, the perfection of all created things ; still there is a flaw, there is a defect, a shortness, limitation is in it. For now, my Soul, thou art but a part of me ; and dost exist in such a manner by succession, that thy security and possession of it is of less than of any thing whatever in the world : for it is of nothing more than of an indivisible ; which, being such, in truth is nothing. But, when the walls shall be broken down, that here confine thee to such a nothing of existence, (which yet is infinitely more noble, than all other degrees of notions) ; then thou shalt sum up time in formal Being, and not be limited, as now thou art, to this so divided a succession. Thou shalt be an hour without divisibility : and, if an hour, a year ; if so, an age ; and, if an age, then for ever, for all Eternity.

But whither art thou flown, my Soul ? to what a daz'ling height art thou mounted ? Thou art now soar'd to such a lessening pitch, as my faint eyes are no longer able to follow thy touring flight. My head grows giddy, with gazing up ; while thou look'st down, to see Time run an infinite distance beneath thee : waisting the existences of all corporal things from nothing to nothing, in a perpetual stream ; and thou secure, and out of the reach of its venomous and all-destroying tooth. Let me call to mind all the violent pleasures of my heady youth ; let me sum up their extent, according to those deceitful measures I then rated happiness by ; let me, in my fancy, chew over again the excessive good, I then fondly imagin'd in them ; and to all this let me add as much more joy and felicity, as, in my weak thoughts, I am able to fathom or but aim at : and then let me say (and with rigorous truth I shall say it) all this excess of Bliss will be resumed, will be enjoy'd to the full, in one indivisible moment. Let me think with my self, if then, when pleasure was the Idol I sacrific'd all my thoughts to, I might, in one quarter of an hour, have enjoy'd a pleasure, or, at least, have hoped for one, that



## CONCLUSION.

141

that should have equalized at once all those, that in my life I ever tasted : what would not I have been content to give, in purchase of that single quarter of an hour ? And, instead of this pleasant dream, I now see, that one real moment will truly and solidly give thee and me the Quintessence, the *Elixir* of content and happiness ; not drawn out of such forty years, as I have strug'led through the world in various fortunes ; but out of ages and ages of pleasure, greater far, than can be conceiv'd, by a heart of flesh, and multiply'd beyond the Arithmetick of Intelligences. And this happy moment shall not be of their sudden fleeting and expiring nature, that are assign'd to time : but shall endure beyond the extent of that time, which surpasses all multiplication. I see plainly, that I must multiply Eternity by Eternity ; to frame a scantling of that Bliss, which a well-passed life in this world shall bring me to in the next. And yet it will be as far short, and as much beneath the self-blessedness of him that gives me this ; as Nothing is short of All that is. For, my Bliss shall have a beginning ; and, though it never shall have end, yet that belongs not to it for its own sake, but proceeds meerly from the bounteous hand of the nothing annihilating *Self-Essence* : from whom there is no more fear of the failing of his liberal super-effluence of Being upon me, than there is of his own deficiency from being *Self-Being*. But how can these things stand together ? that indivisibly I shall possess a tenure beyond all possible time ; and nevertheless, possibly, notwithstanding my possession, I may be bereft of what I enjoy ? Who can read this Riddle ? who can dive into this Abyss ? who can shoot light into this infinite pit of darkness ? It is the abundance and excess of light that here strikes us blind. Who can strengthen our eyes, to endure Eagle-wise this glorious and resplendent Sun ? Nothing, sure, in this world ; unless it be *Silence* and *Solitude*. To these therefore let us consecrate the reverend contemplation of this awful mystery : which is but profaned, if it be exposed to vulgar eyes, and to such night-Owls and Bats as we are ; while the troubled fantasies of reeking sense and worldly occupations, over-cloud my airy thoughts.

Now then, if Nature, by short and thick steps at the beginning, and by large paces in the progress, hath deliver'd us  
over



## CONCLUSION.

over into a night of pure light; where we can see nothing, because every thing is too visible: so that we are fain to veil our eyes, and constrain'd to retire our selves, to meditate and arm them, before we expose them to so strong and glorious beams. How should we dare to look upon those admirable heights (infinitely surpassing all these) with which the over-conquering *Grace* hath crown'd and swell'd up the extent of Nature? What sight is sharp enough to penetrate into the mysterious *Essence*, sprouting into different *Persons*? Who can look upon the self-multiply'd Unity, upon the incomprehensible Circumincession, upon those wondrous Processions, and Idioms reserv'd for Angels eyes?

Of these (my Soul), whose shootings reach infinitely higher, beyond all that we have said, than what we have said is beyond the dull and muddy motions of this life; thou art not capable now of receiving any instructions. Let first the Mystagogical illuminations of the great *Areopagite*, and the Ascetike discipline of the Anachoretical inhabitants of the Wilderness, purifie thy eye; before thou attemptest to speak, or to aim at the discovery of these abysmal depths. By them thou must be, first, irrigated with the sweet shours of mornings and evenings, with the gentle dews, and manna-drops, which fall abundantly from those bounteous favours that reside in a higher sphere than Nature; and that pour out unknown and unconceivable blessings upon prepar'd hearts: which fructifie into that true Bliss; in comparison wherof, all that we have hitherto declared is but shadow, vanity, and nothing.

**FINIS.**



OF THE  
Sympathetick Povvder.  
A  
DISCOURSE  
IN  
A Solemn Assembly  
AT  
*MONTPELLIER.*

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Made, in French,  
BY  
Sir *KENELM DIGBY*, Knight  
1657.

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*LONDON,*  
Printed for *John VVilliams*, 1669.



OF THE  
Gymnastic Powder.

A  
DISCOURSE

A Solenn Address  
BY  
ENOY PELLER.

Delivered at the  
F. A.  
in the Town of New York,  
on the 17th of May, 1784.

LOVDON,  
Printed for John Williams, 1784.





A

## DISCOURSE

OF

The Cure of WOUNDS,

BY THE

POWDER of SYMPATHY.

*My Lords,*

**I** Believe you will remain all in one mind with me, that, to penetrate and know a Subject, 'tis necessary, in the first place, to shew whether the thing be such, as it is supposed or imagined to be : For would not one unprofitably lose both his time and labour, to busie himself in the re-search of the causes, of that which peradventure is but a *Chimera*, without any foundation of truth ?

I remember to have read a place in *Plutarch*, where he proposeth this Question, Why those Horses, who, while they are Colts, have been pursued by the Wolf and saved themselves by force of running, are more fleet than other Horses ? Wherto he answers, That it may be the scaring and affrightment, which the Wolf gives the young beast, makes him try his utmost strength, to deliver himself from the danger that follows



follows him at the heels : therefore, the said fright, as it were, unknits his joynts, and stretches his sinews, and makes the ligaments and other parts of his body the more supple to run ; insomuch, that he resents it all his life afterwards, and becomes a good Courser. Or, perhaps, says he, those Colts, which are naturally swift, save themselves by flying away ; whereas others, who are not so, are overtaken by the Wolf, and so become his prey : and so, it is not because they have escaped the Wolf, that they are the more fleet, but it is their natural swiftness that saves them. He affords also other reasons ; and at last concludes, That it may be the thing is not true. I find it not so fit (my Lords) to reply hereto at a Table Discourse : where the chief design of conversation is to pass away the time gently and pleasantly ; without meddling with the severity of high fetcht reasons, to wind up the spirits, and make them more attentive. But, in so renowned an Assembly as this, where there are such Judicious Persons and so profoundly learned, and who, upon this rancounter, expect from me, that I pay them in solid reasons ; I should be very sorry, that, having done my uttermost to make it clear, How the Powder, (which they commonly call the *Powder of Sympathy*) doth, naturally and without any Magick, cure wounds without touching them, yea, without seeing of the Patient : I say, I should be very sorry, that it should be doubted, Whether such a cure may effectually be perform'd or no.

In matter of fact, the determination of the existence and truth of a thing depends on the report which our Senses make us. This business is of that nature ; Wherin, they, who have seen the effects and had experience therof, and have been careful to examine all necessary circumstances, and satisfied themselves afterwards that there is no imposture in the thing, nothing doubt but that it is real and true ; And, they, who have not seen such experiences, ought to refer themselves to Narrations and Authority of such as have. I could produce divers wherof I was an ocular witness ; nay, *Quorum pars magna fui* : But as a certain and eminent example in the affirmative is convincing, to determine the possibility and truth of a matter in doubt ; I shall content my self (because I would not trespass too much upon your patience at this time) to instance



instance in one only. But, it shall be one of the clearest, the most perspicuous, and the most averred that can be; not only for the remarkable circumstances therof, but also for the hands (which were above the Vulgar) through which the whole business passed. For, the cure of a very sore hurt was perfected by this *Powder of Sympathy*, upon a Person illustrious, as well for his many perfections, as for his several employments. All the circumstances were examined and sounded to the bottom, by one of the greatest and most knowing Kings of his time, viz. King *James* of England; who had a particular talent and marvailous sagacity, to discusse natural things, and penetrate them to the very marrow: As also by his Son, the late King *Charles*, and the Duke of *Buckingham*, their prime Minister. And, in fine, all was registred among the Observations of the great Chancellor, *Bacon*, to add, by way of Appendix, to his Natural History. And I believe, when you shall have understood this History, you will not accuse me of Vanity, if I attribute to my self the Introducing this way of Cure, into this Quarter of the World.

Mr. *James Howel*, (well known in *France*, for his publick Works; and particularly, for his *Dendrologia*, translated into French by Monsier *Baudouin*) coming by, by chance, as two of his best friends were fighting in Duel, did his endeavour to part them; and, putting himself between them, seiz'd with his left hand upon the Hilt of one of the Combatants, while with his right he laid hold of the Blade of the other. They, being transported with fury one against the other, struggled to rid themselves of the hindrance their Friend made, that they should not kill one another: and one of them, roughly drawing the Blade of his Sword, cut, to the very bone, the nerves and muscles of Mr. *Howel's* hand: and then the other, disengaging his Hilt, gave a cross blow on his Adversaries head, which glanced towards his Friend; who, heaving up his hand to save the blow, was wounded on the back of his hand, as he had been before within. It seems some strange Constellation reign'd then against him, that he should lose so much blood by parting two such dear Friends, who, had they been themselves, would have hazarded both their lives to have preserved His: But, this involuntary effusion of blood by them, prevented that  
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which they should have drawn one from the other. For they, seeing Mr. *Howel*'s face besmear'd with blood by heaving up his wounded hand, both ran to embrace him : and having search'd his hurts, they bound up his Hand with one of his Garters, to close the Veins which were cut and bled abundantly. They brought him home, and sent for a Chyrurgeon : But this being heard at Court, the King sent one of his own Chyrurgeons ; for his Majesty much affected the said Mr. *Howel*.

It was my chance to be lodged hard by him ; and, four or five dayes after, as I was making my self ready, he came to my House, and pray'd me to view his wounds, : for I understand, said he, that you have extraordinary remedies upon such occasions ; and my Chyrurgeons apprehend some fear, that it may grow to a *Gangrene*, and so the hand must be cut off. In effect, his countenance discover'd that he was in much pain ; which, he said, was insupportable, in regard of the extream inflammation. I told him that I would willingly serve him : but if, haply, he knew the manner how I would cure him, without touching or seeing him, it may be he would not expose himself to my manner of curing ; because he would think it, peradventure, either ineffectual or superstitious. He reply'd, The wonderful things which many have related to me, of your way of medicament, makes me nothing doubt of its efficacy ; and all that I have to say to you is comprehended in the Spanish Proverb, *Hagase el milagro, y hagalo, Mahoma*, Let the miracle be done, though *Mahomet* do it.

I ask'd him, then, for any thing that had the blood upon it ; so he presently sent for his Garter, wherewith his hand was first bound : and as I call'd for a Bason of water, as if I would wash my hands ; I took a handful of Powder of *Vitriol*, which I had in my Study, and presently dissolv'd it. As soon as the bloody Garter was brought me, I put it in the Bason, observing the while what Mr. *Howel* did ; who stood talking with a Gentleman in a corner of my Chamber, not regarding at all what I was doing : But he started suddenly, as if he had found some strange alteration in himself. I ask'd him what he ail'd ? I know not what ails me, said he, but I find, that I feel no more pain : me-thinks, a pleasing kind of freshness, as it were



were a wet cold napkin spread it self over my hand; which hath taken away the inflammation that tormented me before. I reply'd, since then you feel already so good an effect of my medicament, I advise you to cast away all your plaisters; only keep the wound clean, and in a moderate temper 'twixt heat and cold. After dinner I took the Garter out of the water, and put it to dry before a great fire. It was scarce dry, but Mr. *Hewel's* servant came running, to tell me that his Master felt as much burning as ever he had done, if not more; for the heat was such, as if his hand were betwixt coales of fire. I answer'd, that although that had hapned at present, yet he should find ease in a short time; for I knew the reason of this new accident, and I would provide accordingly, so that his Master should be free from that inflammation, it may be, before he could possibly return unto him: but, in case he found no ease, I wish'd him to come presently back again; if not, he might forbear coming. Away he went; and at the instant I put again the Garter into the water; therupon, he found his Master without any pain at all. To be brief, there was no sense of pain afterward; but, within five or six days the wounds were cicatrized, and entirely healed. King *James* required a punctual information of what had passed, touching this cure: and after it was done, and perfected, his Majesty would needs know of me how it was done, having droll'd with me first (which, he could do with a very good grace) about a Magician and a Sorcerer. I answer'd, That I should be always ready to perform what his Majesty should command; but I most humbly desired him before I should passe further, that I might tell him what the Author, of whom I had the Secret, said to the great Duke of *Toscany*, upon the like occasion. It was a Religious *Carmelite*, that came from the *Indies* and *Persia* to *Florence*, he had also been at *China*; who, having done many marvellous cures with this Powder, after his arrival to *Toscany*, the Duke said, he would be very glad to learn it of him. It was the father of the Great Duke, who governs now. The *Carmelite* answer'd him, That it was a Secret which he had learnt in the Oriental parts, and he thought there was not any, who knew it in *Europe* but himself; and that it deserv'd not to be divulged; which could not be hindered, if his Highness would meddle with the practice of it, be-



cause he was not likely to do it with his own hands; but must trust a Surgeon, or some other servant; so that, in a short time divers other would come to know it, as well as himself. But, a few months after, I had opportunity to do an important courtesie to the said Fryar; which induced him to discover unto me his Secret: and the same year he return'd to *Persia*; that now there is no other knows this Secret in *Europe*, but my self. The King replied, That I needed not apprehend any fear that he would discover it; for he would not trust any body in the World to make experience of this Secret, but do it with his own hands: therefore he would have some of the Powder; which I deliver'd, instructing him in all the circumstances. Whereupon his Majesty made sundry proofs; whence he reciv'd singular satisfaction.

In the *Interim*, Dr. *Mayerne*, his first Physician, watch'd to discover what was done by this Secret: and at last he came to know, that the King made use of *Vitriol*. Afterwards he accosted me, saying, he durst not demand of me my Secret, because I made some difficulty to discover it to the King himself: But, having learnt with what matter it was to be done, he hoped I would communicate to him all the circumstances, how it is to be used. I answer'd him, That if he had asked me before, I would frankly have told him all; for, in his hands, there was no fear that such a secret should be prostituted: and so I told him all. A little after the Doctor went into *France*, to see some fair Territories he had purchased near *Geneva*; which was the Barony of *Aubonne*. In this voyage he went to see the Duke of *Mayerne*, who had been a long time his friend and protector; and he taught him this Secret: wherof the Duke made many experiments, which if any other but a Prince had done, it may be they had passed for effects of Magick and enchantments.

After the Dukes death, who was kill'd at the siege of *Montauban*, his Surgeon, who waited on him in doing cures, sold this Secret to divers persons of Quality; who gave him considerable sums for it, so that he became very rich therby. The thing, being fall'n thus into many hands, remain'd not long in termes of a Secret but by degrees came to be so divulg'd,



divulged, that now there is scarce any Country Barber but knows it.

Behold, Sirs, the genealogy of the Powder of Sympathy in this part of the World with a notable History of a cure perform'd by it. 'Tis time now to come to the discussion, how it is done. It must be avowed, that 'tis a marvellous thing, that the hurt of a wounded person should be cured by the application of a remedy put to a rag of cloth or a weapon at a great distance. Yet it is not to be doubted, but after a long and profound speculation of all the oeconomy and concatenation of natural causes, which may be adjudged capable to produce such effects, one may fall at last upon the true ones, which must have subtle resorts and means to act. Hitherto they have been wrap'd up in darknesse, and esteem'd so inaccessible, that they who have undertaken to speak or write of them, (at least those I have seen) have been contented to speak of some ingenious sleight; without diving into the bottom: endeavouring rather to shew the vivacity of their spirit and force of their eloquence, than to satisfy their Readers and Auditors, how the thing is really to be done. They would have us take for ready money some terms, which we understand not, nor know what they signifie. They would pay us with conveniences, with resemblances, with Sympathies; with Magnetical virtues, and such terms, without explicating what these terms mean: They think they have done enough, if they feebly perswade any body that the business may be performed by a natural way; without having any recourse to the intervention of Demons, and Spirits: but they pretend not in any sort to have found out the convincing reasons which demonstrate, how the thing is done.

If I did not hope to gain otherwise upon your spirits; if I did not, I say believe, that I should be able to perswade you otherwise than by words, I would not have undertaken this enterprize. I know too well,

*Quid valeant humeri, quid ferre recusent.*

Such a design requires a great fire, and vivacity of conceptions,



tions, volubility of tongue, aptness of expressions, to insinuate, as it were by surprisal, that which one cannot carry away by a firm foot, & by cold reasons, though solid. A Discourse of this nature challenges other than a Stranger; who finds himself obliged to display his sense in a language, wherein he can hardly express his ordinary conceptions. Nevertheless these considerations shall not deter me from engaging my self in an enterprize, which may seem to some much more difficult, than that which I am now to perform, viz. to make good convincing proofs, that this *Sympathetical cure* may be done naturally; and to shew before your eyes, and make you touch with your finger, how it may be done. You know that Perswasions are made by ingenious arguments, which, expressed with a good grace, rather tickle the Imagination, than satisfy the Understanding: But demonstrations are built upon certain and approved principles; and though they be but roughly pronounced, yet they convince and draw after them necessary conclusions. They proceed, as a strong Engin fastned to a gate to batter it down; or as a plate of metal to imprint the mark of the mony. At every turn, that truth makes, she approaches but little, and as it were insensibly, and makes not much noise, and there is no such great force required to turn her; but her strength, though it be slow, is invincible. That at the end, she breaks down the gate, and makes a deep impression on the piece of Gold or Silver. Whereas the stroke of hammers, and bars, (whereto witty discourses, and the flourished conceptions of Subtile spirits may be compared) requires the arm of a Giant, makes a great noise; and, at the end of the account, produces little effect.

To enter then into the matter I will (according to the method of Geometrical Demonstrations) lay Six or Seven Principles, as foundation-stones, wheron I will erect my Structure. But I will lay them so well, and so firmly, that there shall be no great difficulty to grant them. These Principles shall be like the wheels of *Archimedes*: by the advantage wherof a child might be capable to hale on shore the biggest *Carack* of King *Hieron*; which a hundred pair of Oxen, with all the Ropes and Cables of his *Arsenal*, were not able to stir. So, by the



the strength of these Principles, I hope to waite my Conclusions to a safe Port.

The *First Principle* shall be, that *the whole Orbe or Sphere of the Air is filled with Light*. If it were needful to prove in this point, that *Light* is a material and corporal *Substance*, and not an imaginary and incomprehensible *Quality*, (as many Schoolmen aver), I could do it evidently enough: but I have done this in another Treatise, which hath been published not long since. And it is no new opinion: for, many of the most esteemed Philosophers among the Antients have advanced it; yea, the Great St. *Augustine*, (in his *Third Epistle to Volusian*) acknowledges, that it is his sentiment. But to our present business, whether *Light* be the one, or the other, it matters not; tis enough to explicate its course, and the journies it makes, wherto our Senses bear witness. Tis clear, that, issuing continually out of its source, the *Sun*, and lancing it self by a marvailous celerity on all sides by straight lines, where it encounters any obstacles in its way, by the opposition of some hard or *opaque* body, it reflects; & leaping thence to equal angles, takes again its course by a straight line, till it handies upon some other solid body; & so it continues to make new boundings here & there; till, at the end, being chased on all sides, by the bodies which oppose it in its passage, 'tis tired, and so extinguishes. In the like manner as we see a *Ball in Tennis Court*, being struck by a strong arm against the walls, leaps to the opposite side; so that sometimes it makes the circuit of the whole Court, & finishes its motion near the place where it was first struck. Our very eyes are witnesses of this progress of the *Light*; when, by way of reflexion, it illuminates some obscure place, whither it cannot directly arrive: Or when, issuing immediatly from the *Sun*, & beating upon the *Moon*, or some other of the Planets, the ray's, which cannot find entrance there, bound upon our Earth, (otherwise we should not see them); and there it is reflected, broken & bruised by so many bodies, as it meets in its diversity of reflexions.

The *Second Principle* shall be, that *The Light glancing so upon some body, the rayes which enter no further but rebound from the superficies of the body, carry with them some smal particles or atoms*: just as the *Ball*, whereof we have spoken, would carry with it some of the moisture of the wall, against which 'tis banded, if the plaister thereof were also moist, & as, in effect, it



carried away some tincture of the black, wherewith the walls are coloured. The Reason wherof is, that the Light, that subtil and rarified fire, coming with such an imperceptible haste, (for its darts are within our eyes, as soon as soon as its head is above our Horison, making so many millions of miles in an inimaginable space of time) I say, the Light, beating upon the body which opposes it, cannot chuse but make there some small incisions, proportionable to its rarity and subtility. And these small Atomes being cut and loosned from their trunk, the heat of the light sticks and incorporates it self with the most humid, viscuous, and glewing parts of them; and carries them along with it. Experience shews us this, as well as Reason. For, when one puts some humid cloth to dry before the fire, the fiery rays beating thereon, those which find no entrance, but reflect thence, carry away with them some small moist bodies, which make a kind of mist betwixt the cloth and the fire. In like manner the *Sun* at his rising enlightning the earth, which is moistned either by rain or the dew of the night, his beams raise a Mist, which, by little and little, ascends to the tops of the hills: and this Mist doth rarifie, according as the Sun hath more force to draw it upwards; till at last we lose the sight thereof, and it becomes part of the Air, which, in regard of its tenuity, is invisible to us. These Atomes then are like Cavaliers, mounted on winged Coursers; who ride on still till the Sun, setting, takes from them their *Pegasus* and leaves them unmounted: and then they precipitate themselves in crowds to the Earth, whence they sprung. The greatest part of them, and the most heavy, fall, upon the first retreating of the Sun; and that we call the Serain: which though it be so thin that we cannot see it, yet we feel it, as so many small hammers striking upon our heads and Bodies; principally the elder sort of us. For, young persons, in regard of the boyling of their blood, and the heat of their complexion, thrust out of them abundance of Spirits: which, being stronger than those that fall from the Serain, repulse them, and hinder them to operate on the Bodies, whence these Spirits came forth; as they do upon those that, being grown cold by age, are not guarded by so strong an emanation of their Spirits. The  
Wind



Wind which blows, and is tossed to and fro, is no other than a great River of the like Atomes; drawn out of some solid Bodies, which are upon the earth, and so banded here and there, according as they find cause for that effect.

I remember to have once sensibly seen how the Wind is ingendred. I passed over Mount *Cenis*, to go for *Italy*, towards the begining of Summer; and I was advanced to half the Hill, as the Sun rose clear and luminous: but before I could see his body, because the Mountains interposed, I observed his rays, which gilded the top of the Mountain *Viso*; which is the Pyramid of a Rock, a good deal higher, than Mount *Cenis* and all the neighbouring Mountains. Many are of opinion, that it is the highest Mountain in the World, after the *Pic of Teneriff*, in the *Gran-de-Canary*: and this Mount *Viso* is always cover'd with Snow. I observed then, that, about that place which was illuminated by the Solar rays, there was a Fog: which at first was of no greater extent, than an ordinary Boul; but by degrees it grew so great, that at last, not only the top of that Mountain, but all the neighbouring Hills were canopied all over with a Cloud. I was now come to the top of Mount *Cenis*; and, finding myself in the straight line, which passes from the Sun to Mount *Viso*, I stay'd a while to behold it, while my Servants were coming up the Hill behind: for, having more men to carry my chair, than they had, I was there sooner. It was not long e're I might perceive the said Fog descend gently to the place where I was; and I began to feel a freshness that came over my face, when I turn'd it that way. When all my Troop was come about me, we went descending the other side of Mount *Cenis*, towards *Suz*: and the lower we went, we sensibly found that the Wind began to blow hard behind our backs; for, our way obliged us to go towards the side, where the Sun was. We met with Passengers that were going up, as we down; who told us, that the Wind was very impetuous below, and did much incommodate them, by blowing in their faces and eyes; but the higher they came, it was lesser and lesser. And for our selves, when we were come to the place where they said the Wind blew so hard, we found a kind of Storm: and it encreased still, the lower we went;



till the Sun, being well advanced, drew no more by that line, but caused a Wind in some other place. The people of that Country assured me, that it was there always so; if some extraordinary and violent accident did not intervene, and divert the ordinary course. *viz.* at a certain hour of the day, the Wind raises it self to such a *romb*, or point, and, when the Sun is come to another point, another wind rises; and so from hand to hand it changes the point, till the Sun set: which always brings with it a calm, if the weather be fair; and that always comes from the Mount *Viso*, opposite to the Sun. They told us also that the daily wind is commonly stronger towards the bottom of the Mountain, than towards the top; wherof the reason is evident. For, the natural movement of every body natural encreases always in swiftness, according as it moves forward to its center; and that by the unequal numbers, (as *Galileo* hath ingeniously demonstrated; I did it also in another *Treatise*): that is, to say, if at the first moment it advances an ell, in the second it advances three, in the third five, in the fourth seven, and so it continues to augment in the same manner; which proceeds from the density and figure of the descending body, acting upon the cessibility of the *medium*. And these small Bodies, which cause a wind from Mount *Viso*, are thick and terrestrial: for, the Snow being composed of watry and earthy parts united by the cold, when the heat of the Solar beams disunites and separates them, the viscous parts flie with them; while the terrestrial, being too heavy to fly upward, fall presently downward. This makes me remember a very remarkable thing, which befell me when I was with my Fleet in the Port of *Scanderon* or *Alexandretta*, towards the bottom of the Mediterranean Sea: there they use to dis-imbark, when they go to *Aleppo*, or *Babylon*. I had done already what I had intended to do in those Seas, and happily compassed my design; so it imported me much to return to *England* as soon as possibly I could; and the rather because my Ships were batter'd by a great Fight, I had had a little before, against a formidable power; wherin although I had obtain'd the better, yet, in so furious a dispute, my Fleet was in some disorder, and my Ships full of wounded Men. To advise therefore of the most  
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expedient Course to come to some Harbour, where I might repair my Ships and be in surety; I assembled all my Captains, Pilots, and Mariners, the most experienced of my Fleet: and, having propounded to them my design, they were all of an unanimous opinion, that the surest course was towards the South, and to cast upon *Syria, Judea, Egypt, and Africa*, and render our selves at the streight of *Gibraltar*; sailing so near the main Land, we should have every night some small breezes of wind, whereby we should in a short time make our Voyage. And besides, we should not be in any great danger to meet either with Spanish or French Fleets. For, *England* was at that time in open War with both those Kings, and we had advice, that they had great Fleets abroad, to vindicate some things we had done in prejudice of them both, those sixteen months that we remain'd Master of those Seas: therefore it concern'd us to make towards some safe Port; where we might both refresh our Men, and repair our batter'd Vessels.

My opinion was clean contrary to theirs: for, I believ'd our best Course were, to steer our Course Westward, and to sail along the Coasts of *Cilicia, Pamphylia, Lydia, Natolia, or Asia the Less*; and to traverse the mouth of the *Archipelago*, leave the *Adriatick*, on the right hand, and pass by *Sicily, Italy, Sardinia, Corsica*, the Gulph of *Lion*, and so coast all *Spain*. Telling them, that it would be a great dishonour to us to forsake our best Road, for fear of the Enemy; since our chief business thither was to find them out: and the protection which it pleased God to afford us all along in so many Combats, in going, ought to make us hope the same providence would vouchsafe to guide us in returning. That there was no doubt but the road which I propos'd to them, consider'd simply in it self, was, without comparison, the better, and the more expedite to sail out of the *Mediterranean Sea*, and gain the Ocean; because, said I, although we have the breezes from the Land, as long as we are upon the Coasts of *Syria, and Egypt*, we shall not have them

at



at all while we sail upon the coasts of *Lybia*, where there are those fearful Sands, the *Syrtes*, which are of a great extent, the said coast having no humidity; for there is neither tree nor herb grows there, nor ought else but moving Sands, which cover'd and interred heretofore at one glut the puissant Army of King *Cambyfes*. Now, where there is no humidity, the Sun cannot attract to make a wind: so that we shall never find there, specially in Summer time, any other wind but that Regular one which blows from *East* to *West*, according to the course of the *Sun*, who is the Father of Winds; unless some extraordinary happen, either from the coast of *Italy*, which lies Northward, or from the bottom of *Ethiopia*, where the Mountains of the *Moon* are, and the source of the Cataracts of *Nile*. Therefore, if we were near the *Syrtes*, the winds of *Italy* would be most dangerous to us, and expose us to shipwrack. I reason'd so according to natural Causes, while they of my Council of war kept themselves firm to their Experience; and I would do nothing against the unanimous sense of all: for, though the disposing and resolution of all things depended absolutely upon my self, yet I thought I might be justly accused of rashness or wilfulness, if I should prefer my own advice before that of all the rest. So we took that course, and went happily, as far as the *Syrtes* of *Lybia*: but there our land-breezes fail'd us; and for seven and thirty days, we had no other but a few gentle *Zephirs*, which came from the West, whither we were steering our course. We were constrain'd to keep at anchor all that time, with a great deal of apprehension, that the wind might come from the North, accompanied with a Tempest: for, if that had hapned, we had been all lost; because our anchors had not been able to hold among those moving Sands (for, under water they are of the same nature as they are upon dry land) and so we must have been shipwrackt upon that coast. But God Almighty, who hath been pleas'd I should have the honour to wait on you this day, deliver'd me from that danger. And, at the end of seven and thirty days, we observ'd the course of the clouds very high, which came from South-east; at first but slowly, but by degrees faster and faster: insomuch that, in two days, the wind, which was forming it self a great way off in *Ethiopia*, came,



came, in a tempest, to the place where we rid at anchor, and carried us whither we intended to go; but the force of it was broken before, coming so far.

Out of this Discourse we may infer, and conclude, that, wherever there is any wind, there are also some small Bodies or Atomes, which are drawn from the Bodies, whence they come, by the virtue of the *Sun*, and *Light*; and, that in effect, this Wind is nothing else but the said Atomes agitated, and thrust on by a kind of impetuosity. And so, the winds partake of the qualities whence they come: as, if they come from the *South*, they are hot, if from the *North*, they are cold, if from the *Earth* alone, they are dry, if from the *Marine* or *Sea-side*, they are humid and moist; if from places which produce aromatical substances, they are odoriferous, wholsom, and pleasing: As those from *Arabia Felix*, which produces Spices, Perfumes, and Gums of sweet savour; or that from *Fontenay* and *Vaugirard* at *Paris*, in the season of *Roses*, which is all perfumed: on the contrary, those winds that come from stinking places, viz. from the sulphureous soil of *Pozzuolo*, smell ill: as also those that come from infected places bring the contagion along with them.

My *Third Principle* shall be, that *The Air is full throughout of small Bodies or Atomes*; or rather that, which we call our air, is no other than a mixture or confusion of such Atomes, wherein the aerial parts predominate.

'Tis well known, that in nature there cannot be actually found any pure Element, unblended with others: for the exterior Fire and the Light acting one way, and the internal Fire of every Body pushing on another way, causes this marvellous mixture of all things in all things. Within that huge extent, where we place the Air, there is sufficient space and liberty enough to make such a mixture; which Experience, as well as Reason confirms. I have seen little *Vipers*, as soon as they came from the eggs where they were ingendred, being not yet an inch long: which, conserv'd in a large Gourd, (cover'd with paper tyed round about, that they might not get out, but leaving little pin-holes made in it, that the Air might enter) encreased in substance and bigness so prodigiously, in six, eight, or ten months, that it is incredible; and more sensibly.



sibly, during the season of the *Equinoxes*, when the air is fuller of those æthereal and balsamical atomes, which they drew for their nouriture.

Hence it came that the *Cosmopolites* had reason to say, *Est in ære occultus vitæ cibus*, there is a hidden food of life in the air. These small *Vipers* had but the air only for their sustenance; nevertheless, by this thin viand, they grew, in less than a year, to a foot long, and proportionably big and heavy. *Vitriol*, *Salt-peter*, and some other substances, augment in the same manner, only by attraction of air.

I remember, that upon some occasion, seventeen or eighteen years ago, I had use of a pound of Oil of *Tartar*; it was at *Paris*, where I had then no Operatory. Wherefore I desired *Monsir Ferrier*, a man universally known by all such as are curious, to make me some: for, he had none then ready made, but did it expressly for me. And because, for the calcination of *Tartar*, twenty pound may be as easily made as two, without encrease of charge; he took occasion hereby to make a quantity for his own use. When he brought it me, the oil smelt so strong of the Rose, that I complain'd of his mingling it with that water, whereas I had desired him to do it purely, by exposing it to the humid air: for, I verily thought he had dissolved the Salt of *Tartar* in *Rose-water*. He swore to me that he had not mingled it with any liquor; but had left the *Tartar* calcind within his Cellar, to dissolve of it self. It was then the season of Roses; therefore it seems that the Air, being then full of the atomes which come from the Roses, and being changed into water by the powerful attraction of the Salt of *Tartar*, their smel became very sensible in the place where they were gathered together, as the beams of the Sun do burn, being crowded together in a burning glasse.

There hapned also another marvailous thing, touching this Oil of *Tartar*; which may serve to prove a proposition we have not yet touched: but, not to interrupt the course of the story, I will tell it you by way of advance. It was, that, as the Season of Roses passed, the smel of the Rose vanish'd away from the said Oil of *Tartar*; so that, in three or four months, it was quite gone. But we were much surprized, when, the next year, the said odor of Roses return'd as strong  
as



as ever and so went away again towards winter: which course it still observs. Which made *Monsir Ferrier* keep it as a singular rarity; and the last Summer I found the effect in his house.

We have in *London* an unlucky and troublesome confirmation of this doctrine: for, the air uses to be full of such atomes. The fuel in that great City, is commonly pit-Coal, brought from *Newcastle*, or *Scotland*. This Coal hath in it a great quantity of volatil Salt, very sharp; which being carried on by the Smoke, uses to dissipate it self and fill the air, Wherewith it so incorporates, that, although we do not see it, yet we find the effect: for it spoils Beds, Tapestries, and other household stuffs, that are of any beautiful fair colour; the fuliginous air tarnishing it by degrees. And, though one should lock up his Chamber very clean, and come not thither in a good while, yet at his return, he will find a black kind of thin soot cover all his household-stuff; as we see in Mills there is a white dust, as also in Bakers shops; which uses to whiten the walls, and sometimes gets into cup-boards and chests. The said coal-soot also gets abroad, and fouls cloths upon hedges, as they are a drying; as also, in the Spring time, the very leavs of Trees are besooted therewith. Now, in regard that it is this air which the lungs draw for respiration among the Inhabitants, therefore the flegme and spittle which comes from them is commonly blackish and fuliginous. Moreover, the acrimony of this soot produces another funest effect; for, it makes the people subject to inflammations, and by degrees to ulcerations in the Lungs. It is so corrosive and biting, that, if one put Gammons of Bacon, or Beef, or any other flesh, within the chimney, it so dries it up, that it spoils it. Wherfore, they who have weak lungs quickly feel it; whence it comes to pass, that almost the one half, of them who dye in *London*, dye of pitifical and pulmonical distempers; spitting commonly blood from their ulcerated lungs. But, at the beginning of this malady, the remedy is very easie: It is but to send them to a place where the air is good. Many, who have means to pay the charge of such a journey, come to *Paris*, and they commonly use to recover their healths in perfection. The same inconveniences are also, though the operations  
be



## Of the Powder of Sympathy.

be not so strong, in the City of *Liege*, wherethe Common People burn no other than pit-coals, which they call *haville*. *Paris* it self also though the air about it be excellent, yet is subject to incommodities of that nature. The excessively stinking dirt and chanel of that vast City mingles a great deal of ill allay with the purity of the air; stuffing it every where with corrupted atomes: which yet are not so pernicious as those of *London*. We find that the most neat and polished Silver Plate, exposed to the air, becomes in a short time livid and foul which proceeds from no other cause, than those black atomes, (the true colour of putrefaction) which stick to it. I know a Person of Quality, (and a singular friend of mine) who is lodg'd in a place, where on one side, a great many poor people inhabit, few Carts use to pass, and fewer Coaches. His neighbours behind his house empty their filth and ordures in the middle of the street; which uses hereby to be ful of mounts of filth, to be carried away by Tombrells, but when they remove these ordures; you cannot imagine what a stench what kind of infectious air is smelt thereabout every where. The Servants of my said Friend, when this happens, use to cover their Plate, and Andirons and other of their fairest household-stuff, with Cotton or course Bays; otherwise they would be all tarnished. Yet nothing hereof is seen within the air; however these experiences manifestly convince, that the air is stuffed with such atomes. I cannot omit to add hereto another experiment; which is, that we find by the effects, how the rays of the *Moon* are cold and moist. 'Tis without controversie, that the luminous parts of those rays come from the *Sun*; the *Moon* having no light at all in her; as her eclipses bear witness; which happen, when the Earth is just twixt her and the *Sun*, and by such interposition hinders her to have light from his rays, The beams then which come from the *Moon* are those of the *Sun*; which glancing upon her, reflect upon us, and so bring with them the atoms of that cold and humid-star, participating of the source whence they come. Whence, if one expose a hollow bason, or glass, to assemble them, he shall find, that wheras those of the *Sun* burn by such a conjuncture, these, clean contrary, refresh and moisten in a notable manner, leaving an aquatick and viscuous-glutining kind



kind of sweat upon the glass. One would think it a folly to talk of washing hands in a well polished Silver Bason, wherein there is not a drop of water, yet this may be done; by the reflexion of the *Moon* beams only; which will afford a competent humidity to do it, But they who have tryed this have found their hands, after they are wiped, to be much moister than usually: and this is an infallible way to take away Warts from the hands, if it be often used,

Let us then conclude, out of these premises and experiments, that the Air is full of atomes; drawn from bodies, by means of the light which reflects thereon, or sallying out by the interior natural heat of those bodies, which drive them forth. It may haply seem impossible that there can be an emanation of so many small bodies, that should be spread and carried up and down, so far in the air by a continual flux, (if I may say so) and yet the body whence they come receive no diminution that is perceptible; though sometimes tis visible enough; as, by the evaporations of the Spirits of wine, musk, and other such volatil substances. But, this objection will be null, and the two precedent Principles, render themselves more credible, when we shall settle another, *viz.* That *Every body, be it never so little, is divisible in infinitum*: not that it hath infinite parts, (for the contrary therof may be demonstrated) but it is capable to be divided and subdivided into new parts, without ever coming to the end of the division: And it is in this sense that our Masters teach us that Quantity is infinitely divisible. This is evident to him who shall consider, with a profound imagination, the essence and formal notion of Quantity; which is nothing else but divisibility. But, in regard that this speculation is very subtile and metaphysical, I will serve my self of some geometrical demonstrations to prove this truth; for, they accommodate best with the imagination. *Euclide* teaches us (in the *Tenth Proposition* of his *Sixth Book*), that if one take a short line, and another a long one, and the long one be divided into divers equal parts; the short one may be divided also into as many equal parts, and every one of those parts also into others, and these last into so many more, and so on, without being able ever to come to that which is not divisible.

But



But let's suppose (although it be impossible) that one might divide and subdivide a line, so that at last we should come to an indivisible; and let's see what will come of it. I say then, that, since the line resolves it self into indivisibles, it must be composed of them; let's see whether that may be verified. To which purpose, I take three indivisibles, (and to distinguish them) let them be A, B, C. for, if three millions of indivisibles make a long line, three indivisibles will make a short one. I put them then in a row; First A, then B, so near, that they touch one another: and I say, that B must necessarily possess the same place as, A, or not possess it. If it possess the same place, they both together make no extension: and, by the same reason, neither 3, nor 3000 will do it; but all the indivisibles will unite together, and the result of all shall be but only one indivisible. It must be then, that, being not both in the same place, yet touching one another, one part of B must touch one part of A, and another part not touch it: Then I add the indivisible C, wherof one part shall touch a part of B. which touches not A; and by this means B is copulant, lying between A and C, to make the extension. To do this, you see that we must admit that B hath parts; as the other two also which by your supposition are all indivisible: and this being absurd, the supposition is impossible. But, to render the matter yet more perspicuous, let's suppose that these three indivisibles make one extension, and compose one line; the proposition already cited from *Euclide* demonstrates, that this line may be divided into thirty equal parts, or into as many as you please: insomuch that it must be granted, that every one of these three indivisibles may be divided into three parts; which is point blank against the nature and definition of an indivisible. But, without dividing into so many parts, *Euclide* shews (by his *Tenth proposition* of his *First Element*) that every line may be parted into two equal parts: but this, being composed of indivisibles of unequal number, it must necessarily follow, that, being parted into two, there must be an indivisible more on the one side than on the other, or the middle one be parted into two halves. So that he, who denies that Quantity may be divided in infinitum, entangles himself in absurdities, and incomprehensible impossibilities: And on the contrary, he, who assents



assents to it, will find it no impossibility or inconvenience, that the atoms of all bodies, which are in the air, may be divided, stretcht and carried to a marvailous distance. Our very senses make faith hereof in some sort : There is no body in the World, which we know of, so compact, so solid, and weighty as Gold; yet, to what a strange extent and division may it be brought ! Let's take an Ounce of this massy mettall; it shall be but a button, as big as my fingers end : A beater of Gold will make a thousand leavs or more of this Ounce. Half of one of these leavs shall suffice to gild the whole surface of Silver of three or four Ounces. Let's give this gilded lingot of Silver to them, who prepare Gold and Silver Thrid to make Lace; and let them draw it to the greatest length and subtilty they can; let them draw it to the thinness of a hair, and so this thrid may be a quarter of a league long in extent, if not more; and in all this length there will not be the space of an atom which is not cover'd with Gold. Behold a strange and marvailous dilatation of this half leaf. Let us do the like to all the rest of the beaten Gold; it will appear that, by this means, this small button of Gold may be so extended, as to reach from this City of *Montpellier* to *Paris*, and far beyond it : into how many millions of atoms might not this gilded line be cut with small Scissers.

Now, 'tis easie to comprehend, that this extention and divisibility, made by such gross instruments, as hammers and Scissers, is not comparable to that which is made by the light and rays of the *Sun*. And it is certain, that, if this gold may be drawn into such a great length by spindles or wheels of iron, some of its parts may easily be carried away by those winged Coursers we spoke of before; I mean, by the rays that flie in a moment from the Sun to the Earth.

If I did not fear to prove tedious to you by my prolixity, I would entertain you with the strange subtilty of little bodies; which issue forth from living bodies; by means whereof our Dogs in *England* will pursue the scent of a mans steps, or of a beasts, many miles : and not only so, but they will find, in a great heap of stones, that which a man hath touched with his hand : Therefore, it must needs be, that upon the Earth, or upon the Stone, some material parts of

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the touched body remain : yet the body doth not sensibly diminish ; no more than *Ambergrise*, and Spanish skins, which will send out of them an odour during a hundred years, without any diminution of skin or smell. In our Country they use to sow a whole field with one sort of grain ; to wit, one year with Barley, the next with Wheat, the third with Beans : and the fourth year they let it rest, and dung it, that it may recover its vigor by attraction of the vital spirit it receives from the air ; and so be plow'd up again after the same degrees. Now, the year that the field is cover'd with Beans, Passengers use to smell them at a good distance off, if the wind blow accordingly, and they be in flower. It is a smell that hath a suavity with it, but fading ; and afterwards is unpleasant, and heady. But the smell of *Rosemary*, which comes from the coasts of *Spain*, goes much further. I have sail'd along those coasts divers times, and observ'd always that the Mariners know when they are within thirty or forty leagues of the Continent, (I do not exactly remember the distance) : and they have this knowledge from the smell of the *Rosemary* which so abounds in the fields of *Spain*. I have smelt it as sensibly, as if I had had a branch of *Rosemary* in my hand ; and this a day or two before we could discover land ; 'tis true, the wind was in our faces, and came from the shore. Some Naturalists write that *Vultures* have come two or three hundred leagues off, by the smell of carrens, and dead bodies left in the field, after some bloody Battle ; and it was known that these Birds came from afar off, because none used to breed near. They have a quick smelling ; and it must be that the rotten atoms of those dead Carcasses were transported by the air so far : and those Birds, having once caught the scent, pursue it to the very source, and, the nearer they come to that, the stronger it is.

We will conclude here that which we had to say, touching the great extent of those little Bodies, which, by the mediation of the Sun-beams and of the Light, use to issue out of all Bodies that are composed of Elements ; which throng in the air, and are carried a marvailous distance from the place and bodies where they have their origin and source : the proof and explication of which things hath been the aim of my discourse hitherto.

Now, my Lords, I must, if you please, make you see how  
*These*



These small bodies, that so fill and compound the Air, are oftentimes drawn to a road altogether differing from that which their universal causes should make them hold: and it shall be our Fifth Principle.

One may remark, within the course and œconomy of Nature, divers sorts of attractions. As, that of *Sucking*; whereby I have seen leaden Bullets at the bottom of a long Barrel exactly wrought, follow the air, which one suck'd out of the mouth of the Gun, with that impetuosity and strength, that it broke his teeth. The attraction of water or wine by a *Scyphon* is like to this: for, by means of that, the liquor is made to pass from one Vessel into another, without changing any way the colour, or rising of the lees. There is another sort of attraction which is called *Magnetical*, whereby the *Loadstone* draws the *Iron*. Another *Electrick*, when the *Jet-stone* draws to it *Straws*: There is another of the *Flame*; when the smoke of a Candle put out draws the flame of that which burns hard by, and makes it descend to light that which is out. There is another of *Filtration*, when a humid body climbs up a dry. Lastly, when the *Fire* or some hot body draws the *Air* and that which is mixed therewith.

We will treat here of the two last species of Attraction; I have sufficiently spoken of the rest in another place. Filtration may seem to him who hath not attentively consider'd it, nor examin'd by what circumstances so hidden a Secret of Nature comes to pass, and to a person of a mean and limited understanding, to be done by some occult virtue or property; and he will perswade himself that, within the *Filtre* or straining instrument, there is some secret *Sympathy*, which makes Water to mount up, contrary to its natural motion.

But, he, who will examine the business, as it ought to be, observing all that is done, without omitting any circumstance, will find there is nothing more natural, and that it is impossible it should be otherwise. And we must make the same judgment of all the profound and hidden'st mysteries of Nature; if men would take the pains to discover them, and search into them with judgment.

Behold, then, how Filtration is done. They use to put a long tounge of cloth, or cotten, or spongy matter, within an earthen pot of Water or other liquor; and leave hanging



upon the brim of the pot a good part of the cloth; and one shall see the water presently mount up, and pass above the brink of the Vessel, and drop, at the lower end of the piece of cloth, upon the ground, or into some Vessel. And the Gardners make use of this method, to water their plants and flowers in Summer, by soft degrees. As also Apothecaries, and Chymists, to separate their liquors from their dregs and residences.

To comprehend the reason why the water ascends in that manner, let us nearly observe all that is done. That part of the cloth which is within the water becomes wetted; viz. it receives and imbibes the water through its spongy and dry parts at first. This cloth swells in receiving the water; so, two bodies joyn'd together require more room than one of them would by it self. Let us consider this swelling and augmented extension, in the last thrid of them which touch the water, viz. that on the *superficies*; which, to distinguish from the rest, let us mark at the two ends (as by a line) with A. B. and the third which immediately follows and is above it, with C. D. the next with E. F. the next with G. H. and so to the end of the tounge. I say then, that the thrid A. B. dilating it self and swelling, by means of the water which enters 'twixt it's fibres or strings, approaches by little and little to C. D.; which is yet dry, because it touches not the water: but when A. B. is grown so gross and swol'n, by reason of the water which enters, that it fills all the vacuity and distance 'twixt it and C. D. as also that it presses against C. D. by reason of it's extension, which is greater than the space was betwixt them both; then it wets C. D., because the thrid A. B. being compressed, the exterior part of the water which was in it, coming to be push'd on upon C. D., seeks there a place, and enters within the thrids, and wets them, in the same manner as at first it's exterior and highest part became wet. C. D. being so wetted, will dilate it self as A. B. did; and consequently pressing against E. F. it cannot choose but work the same effect in it, which before it had receiv'd by the swelling and dilatation of A. B. and so, by gentle degrees, every thrid wets its neighbor, till the very last thrid of the



the cloth tounge. And it is not to be feared, that the continuity of the Water will break, ascending this scale of chords; or that it will recoil backwards: for, those little ladders, so easy to be mounted, render the ascent facile, and the woolly fibres of every thrid seem to reach their hands to help them up at every step: and so the facility of getting up, joyn'd with the fluidness of the water, and the nature of quantity, (which tends always to the uniting of substances and bodies which it clothes, when there occurs no other predominant cause to break and divide it) causes that the water keeps it self in one piece, and passes above the brink of the pot. After that, its voiage is made more easie, for it follows its natural tendence, always downwards. And, if the end of the cloth hangs lower without the pot, than the surface of the water within, the water drops into the ground, or some Vessel placed underneath; as we see a chord being hung upon a pully, the longest and heaviest end falls upon the ground, and carries away the shortest and lightest, drawing it over the pully. But, if the end of the cloth, without the pot, were *horizontal* with the surface of the water, and hung no lower than it, the water would be immoveable: as, the two sides of a Ballance, when there's equal weight in both the scales. And, if one should pour out part of the water that is in the pot, so that the *superficies* grow lower than the end of the cloth without: in that case the ascending water becoming more heavy than the descendant on the other side, without the pot, it would call back that which was gone out before and ready to fall; and would make it thrust on and return to its former pace, and enter again into the pot, to mingle with the water there.

You see then this mystery, which at first was surprizing, displaid, and made as familiar and natural, as to see a stone fall down from the air. 'Tis true, that to make a demonstration thereof, exact and compleatly rigorous, we must add other circumstances; which I have done in another Discourse, wherein I expressly treated of this subject. But that which I now say is sufficient, to give a taste how this so notable Attraction is performed.

The other Attraction by Fire, which draws to it the am-  
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bient air, with the small bodies therein, is wrought thus;

The Fire, acting according to its own nature, which it, to push on a continual river or exhalation of its parts, from the center to the circumference, carries away with it the air adjoined and sticking to it on all sides; as the water of a river trains along with it the earth of that channel or bed, through which it glides. For, the air being humid, and the fire dry, they cannot do less, than embrace and hug one another. But, there must new air come from the places circumjacent, to fill the room of that which is carried away by the fire; otherwise there would a vacuity happen, which nature abhors. This new air remains not long in the place it comes to fill; but the fire, which is in a continual career and emanation of its parts, carries it presently away, and draws other: and so there is a perpetual and constant current of the air, as long as the action of fire continues. We daily see the experience hereof: For, if one makes a good fire in ones Chamber, it draws the air from the door and windows; which though one would shut, yet there be crevices and holes for the air to enter, and, coming near them, one shall hear a kind of whistling noise which the air makes in pressing to enter. 'Tis the same cause that produces the sound of the Organ and Flute. And he, who would stand between the crevices and the fire, should find such an impetuosity of that artificial wind, that he would be ready to freeze, while he is ready to burn the other side next the fire. And a Wax-candle held in this current of wind would melt, by the flame blown against the wax, and waste away in a very short time: whereas, if that Candle stood in a calm place, that the flame might burn upward, it would last much longer. But, if there be no passage wherby the air may enter into the Chamber, one part, then, of the vapor of the wood, which should have converted to flame and so mounted up the funnel of the Chimney, descends downward against its nature, to supply the defect of air within the said Chamber, and fills it with smoke; but at last the fire choaks, and extinguishes, for want of air. Whence it comes to pass, that the Chymists have reason to say, that the air is the life of fire, as well as of animals. But, if one puts a Bason or Vessel of water before the  
fire



fire upon the hearth, there will be no smoke in the Chamber; although it be so close shut, that the air cannot enter : for, the fire attracts part of the water, which is a liquid substance and easie to move out of its place ; which aquatic parts rarifie themselves into air, and thereby perform the functions of the air. This is more evidently seen if the Chamber be little ; for then the air, which is there pent in, is sooner rais'd up and carried away. And, by reason of this attraction, they use to make great fires, where there is household-stuff, of persons that dyed of the Pestilence, to dis-infect it. For, by this inundation of attracted air, the fire as it were sweeps the walls, floor, and other places of the Chamber ; and takes away those little putrified, sharp, corrosive, and venomous bodies, which were the infection that adhered to it : drawing them into the fire, where they are partly burnt, and partly sent up into the Chimney, accompanied with the atomes of the fire and the smoke. 'Tis for this reason that the great *Hippocrates*, (who groped so far into the secrets of Nature) dis-infected, and freed from the Plague a whole Province or entire Region ; by causing them to make great fires every where.

Now, this manner of attraction is made, not only by simple fire, but by that which partakes of it, viz. by hot substances: and that which is the reason and cause of the one, is also the cause of the other. For, the Spirits or ignited parts, evaporating from such a substance or hot body, carry away with them the adjacent air ; which must necessarily be supplied by other air or some matter easily rarifiable into air ; as we have spoken of the bason and tub of water, put before the fire to hinder smoke. 'Tis upon this foundation that Physicians ordain the application of Pigeons, or Puppy's, or some other hot Animals, to the soles of the feet, or the hand-wrists, or the stomachs, or navils of their Patients ; to extract out of their bodies the wind or ill vapours which infect them. And, in time of contagion or universal infection of the air, Pigeons, Cats, Dogs, with other hot Animals, which have continually a great transpiration or evaporation of Spirits, use to be killed : because through attraction, the Air taking the room of the Spirits, which issue forth by the evaporation, the pestiferous atomes,



which are scatter'd in the air and accompany it, use to stick to their feathers, skins, or furs.

And, for the same reason, we see that Bread coming hot out of the Oven, put upon the Bung, draws to it the Must of the Cask which would spoil the Wine : and that Onions, and such hot bodies which perpetually exhale fiery parts, (as appears by the strength of their smell) are quickly poison'd with infectious airs, if they be exposed to them : and, 'tis one of the signs, to know whether the whole mass of the air be universally infected.

And, one might reduce to this head the great attraction of air by calcin'd bodies ; and particularly by *Tartar*, all ignited by the violent action of the fire which is crowded and incorporated among it's Salt. I have observed, that it attracts to it nine times more air, than it self weighs. For, if one expose to the air a pound of Salt of Tartar, well calcin'd and burnt, it will afford ten pound of good Oil of Tartar ; drawing to it, and so incorporating the circumjacent air, and that is mingled with it : as it befell that Oil of Tartar, which Monsir *Ferrier* made me, wherof I spake before. But, methinks, all this is but little, compared to the attraction of air by the body of a certain Nun at Rome ; wherof *Petrus Servolus, Urban the Eighth's* Physician, makes mention, in a Book which he hath published, touching the marvailous accidents which he observ'd in his time. Had I not such a vouchy, I durst not produce this History ; although the Nun her self confirm'd it to me, and a good number of Physicians assured me of the truth thereof. There was a Nun, that, by excessive of fasting, watching, and mental orisons, was so heated in her body, that she seem'd to be all on fire, and her bones dryed up and calcin'd. This heat then, this internal fire, drawing the air powerfully ; this air incorporated within her body, as it uses to do in Salt of Tartar : and, the passages being all open, it got to those parts where there is most serosity, which is the bladder ; and thence she rendred it in water among her Urine, and that in an incredible quantity ; for, she voided, during some Weeks, more than two hundred pounds of Water every four and twenty hours.

With



With this notable example I will put an end to the experiments, I have urged to prove and explicate the attraction made of air, by hot and ignited bodies, which are of the nature of fire.

My Sixth Principle shall be, that *When fire or some hot body attracts the Air and that which is within the Air, if it happens that within that air there be found some dispersed atoms of the same nature with the body that draws them; such atoms are more powerfully attracted, than if they were Bodies of a different nature, and they stay, stick, and mingle more willingly with the body which draws them.* The Reason hereof is, the Resemblance and Sympathy they have one with the other. If I should not explicate wherein this Resemblance consisted; I should expose my self to the same censure and blame, as that which I taxed, at the beginning of my discourse, in those, who spake but lightly and vulgarly of the *Powder of Sympathy*, and such marvels of Nature. But, when I shall have cleared that which I contend for by such a resemblance and conveniency; I hope then you will rest satisfied. I could make you see that there are many sorts of Resemblances, which cause an Union between bodies; but I will content my self to speak here only of three signal ones.

The first Resemblance shall be in Weight; whereby bodies of the same degree of heaviness assemble together. The reason wherof is evident. For, if one body were lighter, it would occupy a higher situation than the heavier body; as on the contrary, if a body were more weighty, it would descend lower than that which is less heavy: but both having the same degree of heaviness, they keep company together in *equilibrio*. As one may see by experience in this gentle example; which some curious spirits use to Produce, to make us understand how the *Four Elements* are situated one above the other, according to their weight. They put in a vial the spirit of Wine tinctur'd with red, to represent the Fire, the spirit of Turpentine tinctur'd with blew, for the Air, the spirit of Water tinctur'd with green, and represent the element of Water; And, to represent the *Earth*, the Powder of some solid Metal enamell'd: you see them one upon the other without mixing; and if you shake them together by a violent agitation



on you shal see a Chaos, such a confusion, that it wil seem there's no particular atoms that belong to any of those bodies, they are so huddled pel mel altogether. But, cease this agitation, and you shall see presently every one of these four substances go to its natural place; calling again, & labouring to unite all their atoms in one distinct mass, that you shall see no mixture at all.

The second Resemblance of bodies, which draw one another and unite, is among them which are of the same degree of *Rarity* and *Density*. The nature and effect of Quantity is to reduce to unity all things which it finds; if some other stronger power, (as, the differing substantial Form, which multiplies it) do not hinder. And the reason is evident. For the Essence of Quantity is *Divisibility* or a *Capacity to be divided*, that is to be *made Many*; whence may be inferr'd that Quantity it self is *not-many*; 'tis therefore of it self and in its own nature one continued extension. Seeing then that the nature of Quantity in general tends to Unity, and Continuity; the first differences of Quantity, which are *Rarity* and *Density*, must produce the same effect of Unity, and Continuity in those bodies which participate in the same degree of them. For proof whereof, we find, that water unites and incorporates it self strongly and easily with water, oil with oil, spirit of wine with spirit of wine: but water and oil will hardly unite, nor mercury with the spirit of wine; and so other bodies of differing density and tenuity.

The third Resemblance of bodies which unites and keeps them strongly together, is that of *Figure*. I will not serve my self here with the ingenious conceit of a Great Personage; who holds that the continuity of Bodies results from some smal hooks or clasps, which keep them together; and are different in bodies of a differing nature: But (not to extend my self too diffusively in every particularity) I will say in gross, as an apparent thing, that every kind of body affects a particular Figure. We see it plainly in the several sorts of Salt; peel and stamp them separately, dissolve, coagulate, and change them as long as you please; they come again alwayes to their own natural figure, after every dissolution, and coagulation. The ordinary Salt forms it self alwaies in cubes of foursquare faces; Salt-peter in forms of six faces: Armoniac-salt in *Hexagons*; as the Snow doth, which is sexangular.

Wherto



Wherto Mr. Davison attributes the pentagonary figure of every one of those Stones, which were found in the Bladder of *Monfir Peletier*, to the number of fourscore; for the same immediate efficient cause the Bladder had imprinted its action both on the stones, and the salt of the urine. The Distillators observe, that if they powre upon the dead head of some distillation the water which was distilled out of it, it imbibes it, and reunites incontinently; whereas if one pour on it any other water of an heterogeneous body, it swims on the top, and incorporates with much difficulty. The reason is, that the distill'd water, which seems to be an homogeneous body, is composed of small bodies of discrepant figures; as the Chymists plainly demonstrate: and these atoms being chased, by the action of fire, out of their own Chambers, or beds exactly fitted to them; when they come back in their antient habitations, viz. to the pores which are left in the dead heads, they accommodate themselves, and amiably rejoin and comensurate together. The same happens when it rains, after a long drough: for, the earth immediately drinks up the water, which had been drawn up by the Sun; whereas any other strange liquor would enter with some difficulty. Now that there are differing pores in bodies which seem to be homogeneous, *Monfir Gassendus* affirms, and undertakes to prove, by the dissolution of Salts of differing natures in common water. When, says he, you have dissolv'd in it common Salt, as much as it can bear; if you put in only a scruple more, it will leave it entire in the bottom, as if it were sand or plaister; nevertheless it will dissolve a good quantity of Salt-peter; and when 'tis glutted with this, 'twil dissolve as much of Armoniackal salt, and so others of different figures. So that as I have observed elsewhere, we see plainly by the œconomy of Nature, that bodies of the same figure use to mingle more strongly, and unite themselves with more facility. Which is the reason why those, that make a strong glue, to piece together broken pots of Porcelain or Chrystal, &c. always mingle with the glue the powder of that body, which they endeavour to re-accomodate: and the Goldsmiths themselves, when they go about to solder together pieces of gold, or silver, mingle alwayes their own dust in the solder.

Having hitherto run through the reasons and causes why  
bodies



bodies of the same nature, draw one to another with greater facility and force, than others, and why they unite with more promptitude; lets now see according to our method, how experience confirms this discourse, for, in natural things we must have recourse, *en dernier ressort*, to experience; and all reasoning that is not supported so, ought to be repudiated, or at least suspected to be illegitimate.

Tis an ordinary thing, when one finds he ha's burnt his hand; to hold it a good while as near the fire as he can, and by this means the ignited atomes of the fire and of the hand mingling together, and drawing one another; and the stronger of the two, which are those of the fire, having the mastery, the hand finds it self much eased of the inflammation which it suffer'd. Tis an usual course, though a nasty one, of those who have ill breaths, to hold their mouths open over a Privy, as long as they can; and by the re-iteration of this remedy, they find themselves cured at last; the greater stink of the privy drawing to it, and carrying away, the lesse, which is that of the mouth. They who have been prick'd or bitten by a Viper or Scorpion, hold, over the bitten or prick'd place, the head of a Viper or Scorpion bruised; and by this means the poyson, which, by a kind of filtration crept on to gain the heart of the party, returns back to its principles, and so leavs him well recover'd. In time of common contagion, they use to carry about them the powder of a Toad, and sometimes a living Toad or Spider, shut up in a box; or Arsnick, or some other venomous substance; which draws to it the contagious air, that otherwise would infect the party; and the same powder of a Toad draws to it the poyson of a plague sore. The Farcy is a venomous and contagious humor within the body of a Horse: hang a Toad about the neck of the Horse, in a little bag, and he will be cured infallibly; the Toad, which is the stronger poyson, drawing to it the venome which was within the Horse. Make water to evaporate out of a Stove, or other room, close shut; if there be nothing that draws this vapor, it will stick to the walls of the Stove, and, as it cools, recondense there into water; but if you put a bason or bucket of water into any part of the Stove, it will attract all the vapor which fill'd the chamber, and no part of the wall will be wetted. If you dissolve *Mercury*, which, resolving into smoke, passes



passes into the recipient, put into the head of the limbeck a little therof, and all the *Mercury* in the limbeck will gather there, and nothing will passe into the recipient. If you distil the Spirit of Salt, or of Vitriol, or the Baume of Sulpher, and leave the passage free betwixt the Spirit and the dead head, whence it issued; the Spirits will return to the dead head, which, being fixt and not able to mount up, draws them to it.

In our Country, (( and I think it is so used here, ) they use to make provision for all the year of Venison, at the season that their flesh is best and most savory, which is in *july*, and *August*; they bake it in earthen pots, or Ryecrust, after they have well seasond it with salt and spices; and being cold, they cover it deep with fresh butter, that the air may not enter. Nevertheless tis observ'd, that after all their diligence when the living Beasts, which are of the same nature and kind, are in *Rut*, the flesh in the pot smels very rank, and is very much changed, having a stronger tast; because of the spirits which come at this season from the living Beasts; which spirits are attracted naturally by the dead flesh. And then, one hath much to do to preserve it from being quite spoil'd: but the said season being passed, there is no danger or difficulty to keep it gustful all the year long.

The Wine Merchants ( in this Country, and every where else, where there is Wine, ) observe that, during the season that the Vines are in flower, the Wine, in their Cellars, makes a kind of fermentation, and pushes forth a little white Lee, (which I think they call the *Mother*) upon the surface of the wine: which continues in a kind of disorder, till the flowers of the Vines be fall'n; and then, this agitation or fermentation being ceased, all the wine returns to the same state it was in before.

Nor is it now that this observation hath been made, but, besides divers others, who speak hereof, *St. Ephrem* the Syrian, (in his last Will and Testament, some 1300 years ago, ) reports this very same circumstance of Wine; sensibly suffering an agitation and fermentation within the vessel, at the same time that the Vines seem to exhale their Spirits in the Vineyards. He makes use of the same example in dry Onions, which bud in  
the



the House, when those in the Garden begin to come out of the earth, and fill the air with their Spirits; shewing by these known examples of Nature, the communication between Living Persons, and the souls of the Dead. Now those Viny Spirits that issue from the buds and flowers, filling the air, (as the Spirits of *Rosemary* use to do in *Spain*) are drawn into the Vessels, by the connatural and attractive vertue of the Wine within: and these new volatil Spirits, entring, excite the more fixed Spirits of the Wine, and so cause a fermentation: as if one should pour therein new or sweet wine, for in all fermentations, there is a separation made of the terrestrial parts from the oily, and so the lightest mount up to the *Superficies*, the heaviest become Tartar lees, which sink to the bottom. But, in this Season, if one be not very careful to keep the Wine in a proper and temperate place, and the Cask full and well bung'd; and to use other endeavours which are ordinary with *Wine-Coopers*, one runs a hazard to have his Wine impaired, or quite spoil'd; because volatil Spirits, evaporating again, carry away with them the Spirits of the wine that is barrel'd, by exciting and mingling with them. As in like manner, the Oil of Tartar, which *Monsieur Ferrier* made, attracting to it self the volatil Spirits of *Roses*, diffused in the air in their Season, suffer'd such a fermentation: and made every year new attractions of the like Spirits, in regard of the affinity which this oil had contracted with those Spirits at first; which it lost again still as the Season passed. And tis for the very same reason, that a Table-cloth, or Napkin, spotted with *Mulberries*, or red Wine, is easily whitened again, at the season that the Plants flower; whereas at any other time, these spots can hardly be washed out. But, tis not only in *France*, and other places where Vines are near Cellars of wine, that this fermentation happens: in *England*, where we have not Vines enough to make wine, the same thing is observed; yea, and some particularities farther. Although they make no wine in our Country, to any considerable proportion, yet we have wine there in great abundance, brought over by the *Merchants*. It uses to come principally from three places, viz. from the *Canaries*, from *Spain*, from *Gascogne*. Now, these Regions being under different Degrees and Climates, in point of Latitude, and consequently one Country being hotter or



or colder, than the other; so that the same Vegetals grow to maturity sooner: it comes to pass, that the foresaid fermentation of our differing Wines advances it self more or less, according as the Vines, whence they proceed, do bud and flower in the Region where they grow; it being consentaneous to reason, that every sort of wine attracts more willingly the Spirits of those Vines whence it comes, than of any other.

I cannot forbear making some digression here, to unfold some other effects of Nature; which we see often, and are not less curious, than the most principal we treat of, and will seem to be derived from more obscure causes; notwithstanding, in many circumstances, they depend on the same principles, and, in many, much differing. First, touching *Moles* or marks, which happen to Infants when their mothers, during the time of their pregnancy, have long'd for some particular things. To proceed after my accustomed manner; I will begin with an example. A Lady of high condition, whom many of this Assembly know, at least by reputation, hath upon her Neck the figure of a *Mulberry*; as exactly as any Painter or Sculptor can possibly represent one: for it bears not only the colour, but the just proportion of a *Mulberry*, and is as it were emboss'd upon her flesh. The Mother of this Lady, being with-child, had a great mind to eat some *Mulberries*; and her fancy being satisfied, one of them casually fell upon her neck; the sanguine juice whereof was soon wiped off, and she felt nothing at that time. But the Child being born, the perfect figure of a *Mulberry* was seen upon her Neck; in the same place where it fell upon the Mothers: and every year, in *Mulberry* season, this impression, or rather this excrescence of flesh, grew big, and itch'd.

Another Lady who had the like mark of a *Strawberry*, was more incommodated therewith; for it, not only grew inflamed and itch'd in *Strawberry*-season, but broke, like an Impostume, whence issued forth a sharp corrosive humor. But, a skilful Surgeon took all away, to the very roots, by cauterizing; so that, since that time, she never felt any pain or alteration in that place which incommodated her so much; it being become a simple scar.

Now then, lets endeavour to penetrate, if we can, the causes  
and



and reasons of these marvailous effects. But, to go the more handsomly to work, let us reflect. that, in the actions of all our senses, there is a material and corporal participation of the things we are sensible of, viz. some atoms of the body operate upon our Senses, and enter into their organs; which serve them as funnels, to conduct and carry them to the brain and the imagination. This appears evidently in Vapours and Savours. And for Hearing, the exterior air, being agitated, causes a movement within the membrane or tympane of the Ear, which gives the like shake to the hammer tyed thereto; and that beating upon its anvil, causes a reciprocal motion in the air, which is shut within the crannies of the Ear; and this is that which we usually call Sound.

Touching the Sight, tis evident that the Light, reflecting from the body that is seen, enters into the eyes; and cannot, but bring with it some emanations of the body wheron it reflects; as we have establish'd in our *Second Principle*.

It remains now to shew that the like is done in the grossest of our senses, the Touch or Feeling. And if it be true, as we have shewn, that every body sends forth a continual emanation of atoms out of it self it makes much for the assertion of this truth. But to render it yet more manifest, and take away all possibility of doubt, I will demonstrate it evidently to the eye: wherof every one may make an experience in a quarter of an hour, if he be so curious, yea, in a less compass of time.

I believe you all know the notable affinity betwixt *Gold* and *Quick-silver*. If *Gold* but touches *Mercury*, that sticks close to it, and whitens it so, that it scarce appears *Gold*, but *silver* only. If you cast this blanched *Gold* into the fire, the heat chases and drives away the *Mercury*, and the *Gold* returns to its former colour: but, if you repeat this often, the *Gold* calcines, and then you may pound, and reduce it to powder.

Now, there is no dissolvant in the World that can well calcine and burn the body of *Gold*, but *Quick-silver*. I speak of that which is already formed by Nature; without engaging my self to speak of that which is talked of among the Secrets of Philosophy. Take then, a spoonful of *Mercury* in some porcelan or other dish, and finger it with one hand: if you have a Gold-Ring on the other hand, it will become white and covered



ed with *Mercury*; though it doth not any way touch it. Moreover, if you take a leaf or a Crown of gold in your mouth, and put but one of your toes in a Vessel where *Mercury* is; the Gold in your mouth, though you shut your lips never so close, shall turn white and laden with *Mercury*: then, if you put the Gold in the fire, to make all the *Mercury* evaporate, and re-iterate this thing often, your Gold will be calcin'd, as if you had, by amalgamation, joyn'd *Mercury* therewith corporally. And all this will yet be done more speedily and effectually, if, in lieu of common *Mercury*, you make use of *Mercury* of Antimony, which is much hotter, and more penetrating; and, though you drive it away by force of fire, it will carry away with it a good quantity of the substance of the Gold; that, re-iterating often this operation, there will no more Gold remain for you to continue your experiments. If then, cold *Mercury* doth so penetrate the whole body; we ought not to think it strange, that subtil atoms of fruit composed of many fiery parts will pass with more facility and quickness. I could further make you see how such Spirits & Emanations suddenly also penetrate ev'n steel; though it be a substance so compacted, cold, and hard, that the said atoms keep there residence their many months and years. In a living body, such as is Mans: the intern Spirits aid and contribute much facility to the Spirits that are without, (such as those of Fruits are,) to make their journey to the Brain. The great Architect of Nature in the fabrick of a Human Body, the master piece of corporal nature, hath placed there some intern Spirits, to serve as Sentinels, to bring their discoveries to their General, the *Imagination*, (which is, as it were, the Mistress of the whole family,) wherby the man might know and understand, what is done without his Kingdom, in the great World; and might shun what is noxious and seek after that which is profitable. For, these Sentinels or intern Spirits, with all the inhabitants of the sensitive organs, are not able to judge alone: insomuch, that, if the *Imagination* or thought, be distracted strongly to some other object, these intern Spirits do not know whether a man hath drunk the wine which he hath swallow'd; if perchance, seeing a person who comes to salute him, he fixes his eye upon him all the while, or he listens attentively to the air of some melodious Song or musical Instrument.

N n n



**Instrument.** The inward Spirits therefore bring all their acquisitions to the Imagination; and if she be not more strongly bent upon another object, she falls a forming certain Ideas and Images: for the atoms from without, being convey'd by these intern Spirits to our imagination, erect there the like edifice, or else a model in short resembling the great body whence they come. And if the Imagination hath no more use of those significative atoms for the present, she ranges them in some proper place within her Magazin, the *Memory*; where she can recall, and send them back when she pleases. And if there be any object which causes some emotions in the Imagination, and touches her nearer, than common objects use to do; she sends back her Sentinels, the internal Spirits, upon the Confines, to bring her more particular news. Hence it proceeds that being surprized by some particular person, or other object, that has already some eminent place in his Imagination, be it with desire or aversion, man suddenly changes colour, and becomes now red, then pale, then red again at divers times: according as the Ministers, which are those intern Spirits, go quick or slow towards their object, and return with their reports to their Mistress, which is the Imagination. But, besides these passages we speak of, from the brain to the external parts of the body, by the ministry of the nerv's; there is also a great road from the Brain to the Heart; by which the vital spirits ascend from the Heart to the Brain, to be animated: and hereby the Imagination sends to the Heart those atoms which she hath receiv'd from some external object. And there they make an ebullition among the vital Spirits; which, according to the intervening atoms, either cause a *dilatation* of the Heart, and so gladden it; or contract it, and so sadden it: and these two differing and contrary actions are the first general effects, whence proceed afterwards the particular *Passions*; which require not that I pursue them too far in this place, having done it more particularly else where, and more expressly.

Besides these passages, which are common to all Men and Women, there is another that's peculiar only to females; which is, from the Brain to the *Matrix*: wherby it often falls out that such violent vapours mount up to the Brain; and those



in so great a number, that they often hinder the operation of the Brain and Imagination, causing convulsions and follies, with other strange accidents; and by the same channel, the Spirits or atoms pass with a greater liberty and swiftness to the womb or *Matrix*, when the case requires.

Now, let's consider how the strong Imagination of one man doth marvailously act upon another man, who hath it more feeble and passive. We see daily, that, if a person gape; those who see him gaping are excited to do the same. If one fall in company with persons that are in a fit of laughter, he can hardly forbear laughing, though he knows not, why they laugh: or if one enters into an house where all the World is sad; he becomes melancholy. Women and Children, being very moist and passive, are most susceptible of this unpleasing contagion of the Imagination. I have known a very melancholy woman, which was subject to the disease called the *Mother*; and while she continued in that mood, she thought her self possessed, and did strange things, which among those that knew not the cause, passed for supernatural effects, and of one possessed by the ill spirit, she was a person of quality; and all this hap'ned through the deep resentment she had for the death of her Husband. She had attending her four or five young Gentlewomen; wherof some were her Kinswomen, and others serv'd her as Chamber-maids: All these came to be possessed as she was, and did prodigious actions. These young Maids were separated from her sight and communication; and not having yet contracted such profound roots of the evil, they came to be all cured by their absence: and this Lady was also cured afterwards by a Physician, who purg'd the *atrabilious* humors, and restored her *Matrix* to its former estate. There was neither imposture, or dissimulation in this.

I could make a notable recital of such passions, that hap'ned to the *Nuns* at *Lodun*: but, having done it in a particular Discourse at my return from that Country, where I, as exactly as I could, discussed the point, I will forbear speaking therof at this time. And only pray you to remember, that, when two Lutes or Harps, near one another are both set to the same tune; if you touch the strings of the one, the other consonant Instrument will sound at the same time, though no



body touch it; whereof *Galileo* hath ingeniously rendred the reason.

Now, to make application to our purpose of all that hath been produced about it, I say that, since it is impossible, that any two several persons should be so near one the other as the Mother and the Infant in her womb; one may thence conclude, that all the effects of a strong and vehement Imagination, working upon another more feeble, passive, and tender, ought to be more efficacious in the Mother acting upon her Infant, than when the Imaginations of other persons act upon those who are nothing to them. And, as it is impossible for a Master of Musick, let him be never so expert and exact, to tune so perfectly any two Harps, as the great Master of the Universe doth the two bodies of the Mother and the Infant; so by consequence, the concussion of the principal strings of the Mother, which is her Imagination, must produce a greater shaking of the consonant string in the Infant, to wit, his Imagination, than the string of one Lute being struck, can of the Consonant strings of another. Wherefore, when the Mother sends Spirits to some parts of her body, the like must be sent to those parts of the Childs body.

Now, lets call to memory, how the Imagination of the Mother is ful of corporeal atoms, coming from the *Mulberry* or *Strawberry*, that fel upon her Neck and Brest; and her Imagination being then surprized with an emotion, by the suddenness of the accident, it follows necessarily, that she must send some of these atoms also to the Brain of the Infant, and so to the same part of the body, where she took the stain at first; twixt which and the brain, there pass such frequent and speedy messengers, as we have formerly set forth. The Infant also having his parts tuned in an harmonious consonance with the Mothers, cannot fail to observe the same movement of spirits, twixt his Imaginations and his neck and brest, as the mother did twixt hers: and, these Spirits, being accompanied with atoms of the *Mulberry*, which the Mother convey'd to his Imagination, make a deep impression and lasting mark upon his delicate skin, whereas that of the mothers was more hard. As if one should let fly a Pistol charg'd with powder only, against



against a Marble, the powder would do nothing but sully it a little, which may quickly be rub'd off; but if one should discharge such a Pistol at a Man's face, the grains of the powder would pierce the skin, and stick and dwell there, all his life time, making themselves known by their black-blewish colour, which they always conserve.

In like manner, the small grains or atoms of the Fruit, which passed from the Mothers neck to the Imagination of the Infant, and thence to the same place upon his skin, do lodge and continually dwell there for the future; and serve as a source to draw the atoms of the like fruit dispersed in the air, in their season, (as the wine in the Tun draws to it the volatil spirits of the Vines) and by drawing them, the part of the skin, where they reside, ferments, swells, corrods, inflames, and sometimes breaks. But to render yet more considerable these marvellous marks of longing, (since we are upon this subject), I cannot forbear to touch also another circumstance, which might seem at first to be a miracle of Nature, beyond the causes which I have alledg'd: but having well eventilated it, we shall absolutely find that it depends upon the same principles. 'Tis that oftentimes it falls out, that the impression of the thing desired or longed for by the Mother, sticks on the Child; though the thing it self ne'r toucht the mothers body. 'Tis sufficient, that some other thing fall or unexpectedly beat upon some part of the woman with-child, while such a longing predominates in her imagination; and the figure of the thing so long'd for, will be found at last imprinted on the same part of the body of the Infant, where the Mother receiv'd the stroke. The reason hereof is, that the atoms of the thing long'd for, being rais'd up by the Light, go to the brain of the Mother, through the channel of her eyes, as well as other more material atoms, proceeding from the corporeal touch, would go thither, by the guidance of the nervs: And, of these petty bodies, the mother forms in her imagination a complete model of that whence they flow by way of emanation: Now, if her mind only run on it, these atoms, which are in her imagination, make no other voyage, than to her heart, and thence to the imagination and heart of the Infant; and so cause a reinforcement of the Passion in them both which may be moved



to such a violent impetuosity, that, if the Mother doth not enjoy her long'd-for object, this passion may cause the destruction both of her and her Infant, at least make for great a change in their bodies as may prejudice them both in their healths. But, if some unlook'd-for blow surprize the mother in any part of her body, it often happens that the spirits, which reside in the brain, are immediately sent to that part by her imagination. And, in all such sudden surprisals, either in women or men, these spirits are transported with the more impetuosity, the more the Passion is violent: As, when one loves another passionately, he runs suddenly to the door when any knocks, on that --- *Hylax in limine latrat*, hoping always it is the party that entirely occupies his thoughts, (for *qui amant ipsi sibi somnia fingunt*) who comes to give him a visit. These spirits then moved by this sudden assault, being mingled with the petty bodies or atoms of the long'd-for thing which possesses so powerfully the fantasie, carry them along with themselves to the part of the body which is struck; as also to the same part of the body of the Infant, as well as to his Imagination: and after that, all which hapens is but the same in respect of the Mother and the child; as when the *Mulberry* or *Strawberry* fall upon the neck or breast of the Ladies, with whom I have entertain'd you.

Permit me, my Lords, to enlarge my digression a little further by re-accounting to you a marvailous accident, known all over the Court of England in the confirmation of the activity and impression which the Imagination of the Mother makes upon the body of the Infant in her womb: A Lady that was my Kinswoman, (she was the Neice of *Fitzes*, the Daughter of Count *Arundel*) came to give me visits sometimes in London; she was handsome and knew it well, taking great complacency not only to keep her self so, but to add what which she could further: wherefore being perswaded that black Batches which she used, gave her a great deal of ornament, she was careful to wear the most curious sort. But as it is very hard to keep a moderation, in things which depend more upon Opinion, than Nature; she wore them in excess, and patched most of her face with them. Though that did not much add to her beauty, and I took the liberty to tell her so



yet I thought it no opportunity, then, to do any thing that should give her the least distast: since with so much civility and sweetness she came to visit me. Nevertheless, one day I thought good, in a kind of drolling way so that she might not take any disgust, (and *Ridentem dicere verum quod vetat?*) to tell her of it; so I let my discourse fall upon her great belly, advising her to have a care of her health, wherof she was somewhat negligent: according to the custom of young vigorous women, which know not yet what it is to be subject to indispositions. She gently thank'd me for my care herein; saying, That she could do no more for the preservation of her health, than she did, though she was in that case. You should at least, I reply'd, have a great care of your Child, O! for that, said she, there is nothing can be contributed. Yet, I told her, see how many Patches you wear upon your face: are you not afraid that the Infant in your womb may haply be born with such marks on his face? But, said she, What danger is there that my child should bear such marks, though I put them on artificially? Then, you have not heard, I reply'd, the marvailous effects that the imaginations of Mothers work upon the bodies of their children, while they are yet big with them; therefore I will recount to you some of them. So I related to her sundry stories upon this subject: as, that of the Queen of *Ethiopia*, who was delivered of a white Boy; which was attributed to a Picture of the Blessed Virgin, she had near the teaster of her bed, where bore she great devotion. I urged another, of a woman who was brought to bed of a child all hairie; because of a pourtrait of *St. John Baptist* in the Wilderness, when he wore a coat of Camels hair. I re-accounted to her also the strange Antipathy which the late King *James* had to a naked sword, wherof the cause was ascribed to some *Scotch* Lords, entring once violently into the Bed-chamber of the Queen his Mother, while she was with child of him, where her Secretary, an *Italian*, was dispatching some letters for her: whom they hack'd and kill'd with naked Swords, before her face, and threw him at her feet; and they grew so barbarous, that they had near hurt the Queen herself who endeavour'd to save her Secretary by interposing herself, for her skin was rased in divers places. *Bucanan* makes mention of this Tragedy. Hence it came



that her Son, King James, had such an aversion all his life time to a naked Sword; that he could not see one, without a great emotion of spirits: and, though otherwise courageous enough, he could not over-master his passions in this particular. I remember, when he dub'd me *Knight*; in the ceremony of putting a naked Sword upon my shoulder, he could not endure to look upon it, but turned his face another way; insomuch that, in lieu of touching my shoulder, he had almost thrust the point into my eyes, had not the Duke of *Buckingham* guided his hand aright.

I alledg'd to her divers such stories; to make her apprehend, that a strong Imagination of the Mother might cause some notable impression upon the body of her Child, to his prejudice. And 'pray consider, said I, how attentive you are to your Patches, how you have them continually in your imagination; for, I have observed, that you have look'd on them ten times since you came to this room, in the Looking-glass. Have you, therefore, no apprehension that your child may be born with half-moons upon his face; or rather, that all the black, which you spot in several places up and down may assemble in one, and appear in the middle of his forehead, the most apparant and remarkable part of the visage, as broad as a *Jacobus*: and then, what a grace would it be to the Child. Oimee! said she, rather than that should happen, I will wear no more Patches, and while I am with-child: thereupon instantly she pul'd them all off, and threw them away. When her friends saw her afterwards without Patches; they demanded how it came to pass, that she, who was esteem'd to be one of the most curious Beauties of the Court, in point of Patches, should so suddenly give over wearing them? she answer'd, that her Uncle, in whom she had a great deal of belief, assured her, that, if she wore them, during the time she was with-child, the Infant would have a large black patch in the midst of his forehead. Now, this conceit was so lively engraven in her imagination, that she could not thrust it out: And so this poor Lady, who was so fearful that her child should bear some black mark in its face, yet could not prevent, but it



it came so into the World, and had a spot as large as a Crown of Gold in the midst of the forehead; according as she had figured before in her imagination. It was a Daughter that she brought forth every way very beautiful, this excepted: 'tis but few moneths since, that I saw her bearing the said mole or spot, which proceeded from the force of the Imagination of her Mother.

I need not tell you of your Neighbour of *Carcassona*; who lately was brought to bed of a prodigious Monster, exactly resembling an Ape, which she took pleasure to look upon, during the time she was with-child: for, I conceive you know the story better than I. Nor of the woman of *St. Maixent*, who could not forbear going to see an infortunate child of a poor passenger woman, that was born without arms; and she her self was deliver'd afterwards of such a Monster; who yet had some small excrescences of flesh upon the shoulders, about the place whence the arms should have come forth. As also of her who was desirous to see the execution of a Criminal, that had his head cut off according to the laws of *France*: wherof her affrightment made so deep a print upon her Imagination, that presently falling in labour, before they could carry her, to her lodging, she was brought to-bed, before her time, of a Child who had his head sever'd from his body, both the parts yet shedding fresh blood, besides that which was abundantly shed in the womb; as if the heads-man had done an execution also upon the tender young body within the Mothers wombe. These three Examples, manifestly enough prove the strength of the Imagination: and many others, as true I could produce; which would engage me too far, if I should undertake to clear the causes and unwrap the difficulties that would be found greater in them, than in any of those wherewith I have entertain'd you. Because those spirits had the power to cause essential changes and fearful effects, upon bodies that were already brought to their perfect shapes; and it may be well believ'd, that in some of them there was a transmutation of one *species* to another, and the introduction of a new *Form* into the subject-Matter, totally differing from that which had been introduced at first; at least, if that which most Naturalists tell us, at the animation of the Embryo



Embryo in the womb, be true. But this digression hath been already too long.

To return then, to the great channel and thrud of our Discourse. The examples and experiments, which I have already insisted on in confirmation of the reasons I have alledg'd; clearly demonstrate that Bodies, which draw the atomes dispersed in the air, attract themselvs such as are of their own nature, with a greater force and energy, than other heterogeneous and strange atoms; as Wine doth the vinal spirits; The oyl of Tartar perfum'd in the making, with Roses, drew the volatil spirits of the Rose; The flesh of Deer, or Venison buried in crust, attracts the spirits of those Beasts; and so all the other wherof I have spoken.

The History of the *Tarantula*, in the kingdom of *Naples*, is very famous. you know how the venome of this Animal, ascending from the part that was bitten, towards the head and heart of the Parties; excites in their Imagination an impetuous desire to hear some melodious airs; and most commonly they are delighted with differing airs. Therefore, when they hear an air that pleases them, they begin to dance incessantly; and, therby fall a sweating in such abundance, that a great part of the venome evaporates. Besides, the sound of the musick raises a movement, and causes an agitation among the aerial and vaporous Spirits in the brain, and about the heart; and diffused up and down through the whole body, proportionably to the nature and cadence of such Musick! as, when *Timotheus* transported *Alexander the great* with such a vehemency, to what Passions he pleas'd: and, as when one Lute struck makes the consonant strings of the other to tremble, by the motions and tremblings which it causes in the air; though they be not touch'd otherwise at all. We find too, oftentimes, that Sounds (which are no other thing, than Motions of the air,) cause the like movement in the Water: as, the harsh sound, caus'd by rubbing hard with ones finger, the brim of a glass full of water, excites a noise, a turning, and boundings, as if it danced according to the cadence of the Sound: The harmonious Sounds also of Bells, in those Countries where they use to be rung to particular tunes, makes the like impressions upon the superficies of the Rivers that are nigh the Steeple, as in the Air especially in the night time, when



when there is no other movement, to stop or choak the other supervenient one. For, the air being contiguous, or rather continuous, with the water; and the water being susceptible of movement; ther's the like motion caused in the fluid parts of the water, as began in the air. And, the same contract, which is betwixt the agitated air, and the water by this means moved to; happens also to be betwixt the agitated air, and the vap'rous Spirits in those bodies that have been bitten by the *Tarantula*; which Spirits, by consequence, are moved by the agitated air, that is to say, by the Sound; and that the more efficaciously, the more this agitation or Sound is proportion'd to the nature and temperature of the party hurt. And, this intern agitation of the Spirits and vapours helps them to discharge the vaporous venom of the *Tarantula*, which is mixt among all their humours: as standing puddle Waters and corrupted airs, putrified by long repose, and the mixture of other noisome substance, are refin'd and purifi'd by motion. Now, winter approaching, which destroys these Animals, the persons are freed from this malady; but at the return of that season when they use to be bitten, the mischief returns, and they must dance again as they did, the year before. The reason is, that the heat of Summer revives these Beasts, so that their venom becomes as malignant and furious as before; and, that being heated and evaporating it self, and dispersing in the air the leven of the same poyson, which remains in the bodies of them who have been hurt, that draws it to it self; wherby such a fermentation is wrought, as infects the other humours; and thence a kind of steam issuing and mounting to the brain, uses to produce such strange effects.

It is also well known that, where there are great dogs or Mastifs (as in *England*) if any be bitten perchance by them, they commonly use to be kill'd; though they be not mad; for fear, least the leven of the canine choler which remains within the body of the party bitten, might draw to it the malignant spirits of the same dog, (should he afterwards chance to be mad) which might come to distemper the spirits of the person. And, this is not only practised in *England*, where there are such dangerous dogs; but also in *France*; according to the report of *Platen Cheron*, Provincial of the *Carmelites* in this Countrey. In his *examen de la Theologie mystique*, newly imprinted, and which I have lately read.



I will say nothing of artificial Noses, made of the flesh of other men, to remedy the deformity of those, who by an extreme excess of cold, have lost their own: which new Noses putrifie, as soon as those persons, out of whose substance they were taken, come to die; as if that small parcel of flesh, engrafted on the face, lived by the spirits it drew from it's first root and source. For, though this be constantly avouch'd by considerable Authors, yet I desire you to think that I offer you nothing which is not verified by solid tradition; such, that it were a weakness to doubt of it.

But, it is high time that I come now to my *Seventh* and last Principle: it is the last turn of the engine, and will, I hope, batter down quite the gate which hindred us an entrance to the knowledge of this so marvailous a mystery; and imprint such a lawful mark upon the doctrine proposed, that 'twill pass for current. This principle is, that *The source of those spirits or little bodies, which attract them to it self, draws likewise after them that which accompanies, and whatever sticks and is united to them.* This conclusion needs not much proof, being evident enough of it self. If there be nails, pins, or ribands, tied to the end of a long chord or chain, and withal a lump, either of wax, gum, or glue; and I take this chord or chain by one end, and draw it to me, till the other end come to my hand: it cannot be otherwise but, at the same time, the nails, the pins, the ribands, the lump, and in fine, all that hangs at it must come to my hand. I go therefore to relate to you, only, some experiments that have been made, in consequence of this Principle; which will most strongly confirm the others produced before.

The great fertility and riches of *England* consists chiefly in pasturage for Cattle; wherof we have the fairest in the world, principally of Oxen and Kine. Ther's not the meanest Cottager, but hath a Cow to furnish his Family with milk: 'tis the principal sustenance of the poorer sort of people, as 'tis also in *Switzerland*; which makes them very careful of the good keeping and health of their Cows. Now, if it happen that the Milk boil over, and so comes to fall into the fire, the good woman or maid presently gives over whatever she is adoining and runs to take the Vessel off the fire: and, at the same time, she takes a handful of Salt, which uses to be commonly in the corner of the Chimney to keep it dry; and throws it upon the cinders where the milk



was shed. Ask her, wherefore she doth so? and she will tell you, 'tis to prevent a mischief to the Cows Udder, which gave this milk: for without this remedy, it would grow hard and ulcerated; and she would come to piss blood, and so be in danger to die. Not that 'twould rise to this extremity the first time; but she would grow ill-disposed, and if this should happen often, the Cow would soon miscarry. It might seem that there were some superstition or folly in this: but the infallibility of the effect warrants from the last, and, for the first, many indeed believe that the malady of the Cow is supernatural, or an effect of Sorcery, and consequently that the remedy which I have alledg'd is superstitious; but 'tis easie to disabuse any man of this perswasion, by declaring how the business goes, according to the foundations I have laid. The milk falling upon the burning coals is converted to vapour, which disperses and filtreth it self through the circumambient air, where it encounters the Light and Solar rays which transport it further; augmenting and extending still farther the Sphere of its activity. This vapour of the milk is not alone or simple; but compos'd of fiery atoms, which accompany the smoke and vapour of the milk, mingling and uniting themselves therewith. Now, the sphere of the said vapour extending it self to the place where the Cow is; her Udder, which is the source whence the milk proceeded, attracts to it the said vapour, and sucks it in together with the fiery atoms that accompanied it. The Udder is, part, glandulous and very tender; and consequently very subject to inflammations: this fire then heats, inflames, and swells it; and in fine, makes it hard and ulcerated. The inflamed and ulcerated Udder is near the Bladder; which comes likewise to be inflamed: making the *anastomoses* and communication 'twixt the veins and arteries to open and cast forth blood, and to regorge into the bladder, whence the Urine empty's it self. But, whence comes it, you will ask, that the Salt remedies all this? 'Tis because that is of a nature clean contrary to the fire; the one being hot and volatil, the other cold and fixed: insomuch that, where they use to encounter, the Salt, as it were, knocks down the fire, by precipitating and destroying its action; as may be observ'd in a very ordinary accident. The chimneys which are full of Soot use to  
take



take fire very easily; and, the usual remedy for this is to discharge a Musket in the funnel of the Chimney, which looseth and brings down with it the fired Soot, and then the disorder ceases: but, if there be no Musket, or Pistol, or other Instrument to fetch down the Soot, they use to cast a great quantity of Salt on the fire below; and that chokes, and hinders the atoms of fire, that otherwise would incessantly mount up and joyn with them above, which, by this means wanting nouriture, consume themselves, and come to nothing. The same thing befalls the atoms which are ready to accompany the vapour of the milk; the salt precipitates and kills them on the very place: and if any chance to scape and save themselves, by the great strugglings they make, and go along with the said vapour, they are nevertheless accompanied with the atoms and spirit of the Salt sticking to them; which, like good wrestlers, never leave their hold, till they have got the better of their Adversary. And you may please to observe by the by, that that there is not a more excellent balme for a burn, than the spirit of salt, in a moderate quantity. 'Tis then apparent, that there cannot be employ'd any means more efficacious, to hinder the ill effects of the fire upon the Udder of the Cow; than to cast upon her milk, that has boil'd over upon the Cinders, a sufficient quantity of Salt. This effect, of securing the Cows Udder upon the burning of her milk, makes me call to mind, what divers have told me they have seen both in *France* and *England*, viz. when the Physicians examine the milk of a Nurse, for the Child of a Person of Quality, they use to make proofs several ways, before they come to judg definitively of the goodness thereof; as, by the taste, by the smell, by the colour and consistence of it: and sometimes they cause it to be boil'd, till it come to an evaporation and they see it's residue, with other accidents and circumstances which may be learnt and discern'd by this means. But, those, of whose milk this last experiment hath been made, have felt themselves so tormented in their Paps, while their milk was a boiling; that, having once endured this pain, they would never consent that their milk should be carried away out of their sight and presence: though they willingly submitted to any other proof than that by fire.

Now



Now, to confirm this experiment of the attraction which the Cows Udder makes of the fire and vapour of the burnt milk, I am going to recount to you another of the same nature; wherof I my self have seen the truth more than once, and wherof any one may easily make trial. Take the excrement of a Dog, and throw it into the fire, more than once; at first you shall find him heated and moved, but, in a short time, you shall see him, as if he were burnt all over, panting and stretching out his tongue, as if he had run a long course. Now, this alteration befalls him, because his entrails, drawing to them the vapour of the burn'd excrement, and, with that vapour, the atoms of fire which accompanied it, grow so chang'd and inflam'd, that the Dog, having always a Fever upon him, and not being able to take any nourishment, his flanks cling together and he dies. 'Twere dangerous to divulge this experience among such persons, as are subject to make use of any thing for doing of mischief: for, the same effect, would be wrought upon Mens Bodies, if one should try the conclusion upon their excrements.

There hap'ned a remarkable thing to this purpose, to a neighbor of mine in *England*, the last time I was there: He had a very pretty Child, whom because he would have always in his eye, he kept the Nurse in his House. I saw him often, for he was a stirring man, and of good address; and I had occasion to use such a man. One day I found him very sad, and his Wife a weeping: wherof demanding the reason, they told me that that their little Child was very ill; that he had a burning Fever, which inflamed him all over, as appear'd the redness of his face; that he strove to go to Stool, but could do little, and that little he did was cover'd with blood; and that he refused also to suck: And that which troubled them most was, that they could not conjecture how this indisposition come; for his Nurse was very well, her milk was as good as could be wished; and in all other things there was as much care had of him as could be. I told them, that the last time I was with them, I observ'd one particularity, wherof I thought fit to give them notice; but something or other still diverted me; 'twas this, that the Child, making a sign that he was desirous to be set on his feet, let fall his excrements on the ground; and



and his Nurse presently took the Fire-shovel and cover'd them with embers, and then threw all into the fire: The mother began to make her excuses, that they were not more careful to correct this ill habit of the child; telling me that, as he advanc'd in years, he should be corrected for it. I replied, that 'twas not for this consideration that I spake of it: but searching after the reason of her child's distemper, and consequently to find some remedy. And thereupon, I related to them the like accident which had hap'n'd, two or three years before, to a child of one of the most illustrious Magistrates of the Parliament of *Paris*; who was bred up in the House of a Doctor of Physick of great reputation in the same Town: I told them also what I have now related to you, touching the excrements of Dogs. And I made reflections to them upon a thing they had often heard, and which is often practis'd in our Country; *viz.* that, In the Villages, which are always dirty in the winter, if there happens to be a Farmer any thing more neat than others, and that keeps the approaches to his House cleaner than his neighbours do, the Boys use to come thither, in the night time or when it begins to be dark, to discharge their bellies there: because, in such Villages there is not much commodity of easments; besides that in such clean places the knaves are out of danger to sink into the dirt, which otherwise might rise up higher than their shooes. The good housewives in the morning, when they open their doors, and find such an ill-favour'd smell, use to be transported with choller: But they, who are acquainted with this trick, go presently and make red hot a Spit, or Fire-shovel, and thrust it so into the excrements, and when 'tis quencht, they heat it again and again to the same purpose. Mean while the Boy, that had plaid the sloven, feels a kind of pain and collick in his bowels, with an inflammation in his fundament and a continual desire to go to Stool: and he is hardly quit of it, till he suffer a kind of Feaver all that day; which makes him return thither no more. And these women, to be freed from such affronts, pass among the Ignorant for Sorceresses, and to have made a compact with the Divel; since they torment people in that fashion, without seeing or touching them. This Gentleman did not disallow those things



things I have already told you ; but was confirm'd farther when I wish'd him to look farther into the fundament of his child, for without doubt he should find it red and inflamed, and perhaps full of pimples, and excoriated. Not long after, this poor child grew ill, and with much pain and pitiful cries, voided some small matter : which in lieu of casting into the fire or covering it with embers, I caused to be put into a basin of cold water and set in a cool place. This was continued to be done, every time the child gave occasion ; and he began to amend the very same hour, and, within four or five daies became perfectly well recover'd. But, lest I trespass too much upon your patience, I'll hold you no longer, but with one experiment more, very familiar in our Countrey : and then I will sum up all that hath been said ; to make you see the force and import of this whole Discourse.

We have in *England*, as I touch'd before, excellent Pasturage for the feeding and fattening of Cattle ; so abundant, that it falls out often, the Oxen come to acquire such excess of fat that it extends itself in a great quantity to their legs and feet and even hoofs ; which many times causes impostumes in the of their feet that comes to swel and get a core full of putrified matter, so that the Beast is not able to go. The Owners observing that, though the Beef be never the worse for the Shambles, yet they are damnified therby ; because, not being able to bring them to *London*, (where the grand market is for fat Beefs through all *England*, as *Paris* is for *Auvergne*, *Normandy*, and other provinces of *France*;) they are constrain'd to kill them up on the place, where their flesh is not worth half the price they might have got in *London*: the Owners, I say, have recourse to this remedy viz. Observing where the Oxe, Cow, or Heifer, fix upon the Ground the sick foot, at first rising up in the morning ; that very turf with the print of the foot on it, they cut up, and hang upon a tree or hedg lying open to the North wind : And, that wind blowing upon the turf, the Beast comes to be cured, within three or four daies, very perfectly, but if one should put that turf towards the South or South west wind the foot would grow worse. These circumstances wil not seem superstitious to you when you shall have consider'd, how, that, by the repose of the night, the corrupt matter or core uses to gather, in a

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great



great quantity under the foot of the Beast ; which being set on the ground in the morning presses forth the impostume : the matter wherof sticks to the place. Now, this turf of Earth being exposed in some proper place, to receive the dry cold blasts of the Northern winds ; those blasts intermingle with the said corrupt impostumated matter : which spreading its Spirits about through all the air, the ulcerated foot of the Animal, (being their source) draws them to it, and with them the cold dry atoms which cure it ; the malady requiring no other help than to be well dry'd, and refreshed. But, if one should expose this turf to a moist hottish wind, it would produce contrary effects.

Behold, my Lords, all my wheels formed ; I confess they are ill filed and polished, but let us try whether, being put together and mounted, they will make the engin go : which, if they do, and fairly draw in the Conclusion, you will, I presume, have the goodness to pardon the grossness of my language ; and, passing by the words, content your selves with the naked truth of the things. Let us therefore apply what has been said, to that which is practic'd, when a hurt person is cured. Let us consider *Mr. Howel* wounded in the hand, and a great inflammation following upon his hurt ; his Garter is taken, cover'd with the blood that issued from the wound, and is steep'd in a bason of water where *Vitriol* was dissolv'd, one keeps the Bason in a closet moderately warm'd by the Sun all day ; and at night in the chimney corner ; so that the blood upon the Garter be always in a good natural temperament, neither colder nor hotter than the degree required in a healthful body : What now must result, (according to the doctrine that we endeavour to establish,) from all this ? In the first place, the Sun and Light will attract, a great extent and distance off, the spirits of the blood upon the Garter : and the moderate heat of the chimney, acting gently upon the composition, (which comes to the same thing, as if one should carry it dry in his pocket, to make it feel the temperate heat of the Body,) will push out and thrust forward still the said atoms, and make them march of themselves a good way in the air round about, to help thereby the attraction of the Sun and Light.

Secondly, the Spirit of *Vitriol*, being incorporated with the blood



blood cannot choose but make the same voyage together with the atoms of the blood. Thirdly, the wounded hand expires and exhales, in the mean time, continually abundance of hot fiery Spirits, which stream as a river out of the inflamed hurt: nor can this be, but the wound must, consequently, draw to it the air which is next it. Fourthly, this air must draw to it the other air next it, and that the next to it also; and so there will be a kind of current of air drawn round about the wound. Fifthly, with this air will come to incorporate at last the atoms and Spirits of the Blood and *Vitriol*, which were diffused a good way off in the air, by the attractions of the Light and the Sun: Besides, it may well be, that, from the beginning, the orb and sphere of these atoms and Spirits extended it self to so great a distance; without having need of the attractions of the air, or light to make them come thither. Sixthly, the atoms of blood, finding the proper source and original root whence they issued, will stay there, re-entering into their natural beds and primitive receptacles: whereas the other air, being but a passenger, will evaporate away as soon as it comes; as, when it is carried away through the funnel of the chimney, as soon as it is drawn into the chamber by the door. Seventhly, the atoms of the blood being inseparable from the Spirits of the *Vitriol*, both the one and the other will joyntly be imbibed together within all the corners, fibres, and orifices of the Veins which lye open about the wound; whence it must of necessity be refreshed, and in fine imperceptibly cured.

Now to know in virtue of what such an effect and cure is so happily performed, we must examine the nature of *Vitriol*: which is composed of two parts; the one fixed, the other volatile. The fixed, which is the Salt, is sharp and biting, and caustique in some degree. The volatile is smooth, soft, balsamical, and astringent; and 'tis for that reason that *Vitriol* is made use of, as a sovereign remedy for the inflammations of the eyes, when they are corroded and parched by some sharp and burning humor or defluention; as also in injections, where excoriations require them, and in the best plaisters to stanch the blood and incarnate hurts. But, they who well know how to draw the sweet oyl of *Vitriol*, which is the pure volatile part thereof, know also that in the whole closet of Nature, there is no balm like this oyl:



For, it heals in a very short time, all kind of hurts which are not mortal, it cures and consolidates the broken veins of the breast; ev'n to the Ulcers in the lungs, which is an incurable malady without this balm. Now, 'tis the volatil part of the *Vitriol*, which is transported by the Sun (the great Distiller of Nature) and which by that means dilates it self in the air: and that the wound or part which receiv'd the hurt, draws and incorporates with the blood and its humours and spirits. Which being true, we cannot expect a less effect of the volatil *Vitriol*, but that it should shut the veins, stanch the blood, and so, in a short time heal the wound.

The method and primitive manner how to make use of this Sympathetical remedy was, To take only some *Vitriol*, and that of the common sort, as it came from the Druggists, without any preparation or addition at all; and to make it dissolve in fountain (or rather in rain-water,) to such a proportion, that, putting therein a knife or some polished iron, it should come out chang'd into the colour of copper: and, into this water, they used to put a clowt or rag embrued with the blood of the party hurt; if the rag were dry: But, if the rag was yet fresh, and moist with the reaking blood, there was no need but to sprinkle it with the smal powder of the same *Vitriol*; so that the powder might incorporate it self with, and imbibe the blood remaining yet humid. In both cases the rag was to be kept in a temperate heat or place; viz. the powder in ones pocket, and the water (which admits not of this commodity) within a chamber where the heat should be temperate, and, every time that one should put new water of *Vitriol* or fresh powder to new cloth or other bloodied stuff, the patient would feel new ease; as if the wound had been then drest with some sovereign medicament. And for this reason they used to reiterate this manner of dressing both Evening and Morning.

But now, the most part of those who serve themselves with the *Powder of Sympathy* endeavour to have *Vitriol* of *Rome*, or of *Cyprus*; which they calcine at the rayes of the Sun: And besides, some use to add the Gum of *Tragacantha*; it being easy to add to things already invented.

For mine own part, I have seen as great and admirable effects of simple *Vitriol*, of eighteen pence the pound; as of that  
Powder



Powder which is us'd to be prepared now at a greater price: yet I blame not the present practice; on the contrary, I commend it, for, it is founded upon reason. For

First, it seems that the purest and best sort of *Vitriol* operates the best.

Secondly, it seems also, that the moderate calcining thereof at the rays of the Sun takes away the superfluous humidity of the *Vitriol*; and operates on no part thereof, but that which is good: as if one should boil broth so clear that it would come to be gelly, which certainly would render it more nourishing.

Thirdly, it seems, that the exposing of the *Vitriol* to the Sun, to receive calcination, renders its spirits more fitly disposed to be transported through the air by the Sun, when need requires. For, it cannot be doubted but some part of the æthereal fire or Solar rays incorporates with the *Vitriol*; (as is plainly discover'd in calcining *Antimony* by a Burning-glass; for it much augments the weight of it, almost half in half:) both are near-a-kin: those therefore, easily obeying the Motion of their brother-beams, must needs make the grosser matter, they are united with less refractory.

Fourthly, these Solar rays, being embodied with the *Vitriol* are in a posture to communicate to it a more excellent virtue, than it hath of it self; as we find that *Antimony*, calcin'd in the Sun becomes (of rank poison that it was before) a most sovereign and balsamical medicament, and a most excellent Corroborative of Nature.

Fifthly, the Gum of *Tragacantha*, having a glutinous faculty, and being, in other respects very innocent, may contribute something towards the consolidation of the wound.

My Lords, I could add many most important considerations touching the Form and essence of *Vitriol*; wherof the substance is so noble, and the origin is so admirable, that one may avouch it, with good reason, one of the most excellent bodies which Nature hath produced.

The *Chymists* assure us that it is no other than, a corporification of the Vniversal Spirit which animates and perfects all that hath existence in this sublunary World: which it draws in that abundance to it, that I my self have, in a short time, by



exposing some only to the open air, made an attraction of a celestial *Vitriol* ten times more in weight, of a marvellous pureness and virtue; a privilege given to none but It, and pure virgin Salt-peter.

But to anatomise, as we ought, the nature of this transcendent Individual, (which nevertheless in some respect may be said to be Universal, and fundamental to all bodies,) would require a Discourse, far more ample, than I have yet made. And I have already entertain'd you so long, that it would be a very great indiscretion to entrench further upon your goodness, who have hitherto listned to me with so much attention and patience; if I should go about to enter into any new matter, and embark myself for a further voyage. Wherefore remitting several things to some other time, when you shall please to command me, and returning to the general consideration of this Sympathetical cure I will put a Period to this Discourse: after I shall have said two or three words, which will not be of small importance, for the confirmation of all that hath been alledg'd by me hitherto. I have deduced to you the admirable causes of the operations, and strange effects of the *Powder of Sympathy*, from their first root. These fundamental causes are so linked one within the other, that it seems there can be no default, stop, or interruption, in their proceedings. But we shall be the better fortified in the belief of their virtue and efficacy, and how they come to produce the effects of so many rare Cures, if we consider that when any juggling is practiced in some one of these causes, or in all of them together, we may perceive immediately an effect altogether differing from the former. If I had not formerly seen a *Watch* or *Clock*, I should be justly surprized and remain astonish'd, to see the hand or needle so regularly mark the journal hours and motion of the Sun, upon the flat of a *Quadrant*; and that it should turn and make its round every four and twenty hours; there being nothing seen that should push on the said needle. But, if I look on the other side, I see wheels, refforts, and counterpoises in perpetual movement; which having well considered, I presently suspect, that those Wheels are the cause of the movement and turnings of the said Needle; though I cannot presently discern or know how they effect it, because of the plate, that lies interposed betwixt



betwixt them. Therupon, I reason thus with my self, Every effect whatever must of necessity have some cause; therefore the body moved there, must necessarily receive its movement from some other body contiguous to it: Now, I see no other body, to make the needle of the quadrant move and turn, but the said wheels; Therefore, I must of force be perswaded to attribute the movement to them. But, afterwards, when I shall have stop'd the motion of those wheels and taken away the Counterpoise, and observed that suddenly the needle ceases to move; and that, applying again the Counterpoise, and giving liberty for the wheels to turn, the needle returns to her ordinary course, and that I make one wheel go faster, by putting my finger to it, or, by adding more weight to the counterpoise, the needle hastens and advances its motions proportionably: then I grow to be convinced and entirely satisfied; and so absolutely conclude that these Wheels and Counterpoises are the true cause of the motion of the Needle.

In the same manner, if, interrupting the action of any of those causes, which I have established for the true foundation of the Sympathetical Powders virtue, I alter, retard or hinder the Cure of the Wound: I may boldly conclude, that they are the legitimate and genuine true causes of the Cure; and that we need not amuse our selves to search after any other.

Let us then examine the matter by this rule. I have affirm'd that, the *Light* transporting the atoms of the *Vitriol* and Blood, and dilating them to a great extent in the air: the wound or place hurt attracts them, and thereby is immediately refresh'd and eas'd; and consequently comes to be heal'd; by the Spirits of the *Vitriol*, which is of a balsamical virtue. But, if you put the Bason or Powder with the cloth-imbrued with blood into a Cup-board or a corner of some cold room, or into a Cellar, where the *Light* or fresh Air never comes (whence the place is corrupted and full of ill smells,) in that case the wound can receive no amendment, nor any good effect from the said Powder. And, it will fall out in the same manner, if, having put the bason or Powder in some By-corner, you cover them with some thick cloth, stuffing and spongie, which may imbibe the atoms coming forth, and retain the light and rays that enter there, so that they are thereby stop'd and quite lost. More-



Morover, if you suffer the water of *Vitriol* to congeal into ice; or the cloth dip't in it; the party hurt shall be sensible, at the begining, of a very great cold in his wound: but when it is iced all over, he shall feel neither heat nor cold, in regard that congealed cold constipates the pores of the water, so that it ceases to transpire and send forth Spirits. If one wash the bloody Cloth in Vinegar or Lye, (which, by their penetrating acrimony, transport all the spirits of the blood), before the *Vitriol* be applied; it will produce no effect. Yet, if the Cloth be wash'd but with pure simple water, it will nevertheless do something; for, that water carries not away so much; but, the effect will not be so great, as if the Cloth had not been washed at all; for then it would remain full of the spirits of the blood. The same cure is performed, by applying the remedy to the Blade of a Sword which ha's wounded a body; so the Sword be not too much heated by the fire: for that will make all the Spirits of the blood to evaporate; and consequently the Sword will contribute but little to the cure. Now, the reason why the Sword may be dressed in order to the cure, is, because the subtile spirits of blood penetrate the substance of the blade, as far as it went into the body of the wounded party; and, there keep their residence, unless the fire, as I said before, chase them away. For experiment wherof, hold the Blade over a chafing-dish of moderate fire, and you shall discern, on the side opposite to the fire, a little humidity; which resembles the spots that ones breath makes upon looking-glasses, or upon the burnished blade of a sword. If you look upon it through a magnifying-glass, you shall find that this soft dew of the Spirits consists in little bubbles, or blown bladders: and, when once they are entirely evaporated, you shall discern no more upon the weapon, unless it were thrust a new into the body of a living person: nor, from the begining shall you discover any such thing, but precisely upon the part of the blade, which had entred the wound.

This subtile penetration of the Spirits into hard steel, may confirm the belief of such Spirits piercing through the skin of a woman big with child: as I remind, to have proposed to you in my *sixth Principle*.

To confirm all these particulars, I could add, to those I have already



already recounted many notable examples more; but, I fear I have already too much exercised your patience; I will therefore suspend any mention of them at this time; but I offer to entertain any of this Honourable Assembly therewith, when they shall have the curiosity.

I conclude then, my Lords, with representing to you that all this mystery is carry'd and guided throughout, by true natural ways and circumstances; although, by the agency and resorts of very subtle spirits.

I am perswaded my Discourse hath convincingly shew'd you, that, in this Sympathetical cure, there is no need to admit of an action distant from the Patient: I have traced to you a real Communication 'twixt the one and the other; viz. of a Balsamical substance, which corporally mingles with the wound.

Now, it is a poor kind of pusillanimity and faint-heartedness, or rather a gross weakness of the Understanding, to pretend any effects of charm or magick herin; or to confine all the actions of Nature to the grossness of our Senses, when we have not sufficiently consider'd nor examined the true causes and principles wheron tis fitting we should ground our judgment: we need not have recourse to a Demon or Angel in such difficulties,

*Nec Deus interfit, nisi dignus vindice nodus  
Inciderit. ———*

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TEA O Z

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On the 1st of January 1800  
I have the honor to acknowledge the receipt of your letter of the 27th inst. in relation to the above mentioned subject. I have the pleasure to inform you that the same has been forwarded to the proper authorities for their consideration. I am, Sir, very respectfully,  
Your obedient servant,  
J. M. Smith  
Secretary of the Board of Commissioners

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2017

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A  
DISCOURSE

Concerning the  
VEGETATION  
OF  
PLANTS.

Spoken by  
Sir *KENELME DIGBY*, at  
*Gresham-Colledge*, on the 23d. of  
*January 1660.*

At a Meeting of the Society for promoting Philosophical Knowledge by Experiments.

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L O N D O N :

Printed for *John Williams* in *Little-Britain* over against  
*St. Botolph's Church*, 1669.



A

# DISCOURSE

Concerning the

## VEGETATION

OF

## PLANTS

By R. B. DICKERSON

Professor of Botany in the University of

Wisconsin

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1880

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OF THE  
 VEGETATION  
 OF  
 PLANTS

He Subject on which you have commanded me now to discourse to you (most honoured President, and most worthy *Academists*) is of so large an extent, and of so abstruse a nature, and branches out into so many refined Speculations (all which derive their Origine from the same source); that I cannot hope to give you content about it, in so short a space as you have confin'd every one of our Society to, when they have the honour of speaking here: Nor can you with reason expect that, without premeditation, I should be able to penetrate into those most hidden Mysteries of Nature, which this materi leads me necessarily to. For, to give you a due account of the Vegetation of Plants, I should first examine the natures of Rarefaction, of Condensation, of Filtration, of Fermentation, of Attraction, of Imbibition, of Concoction, of Augmentation, of Nourishment, of Assimilation; and of sundry other actions or virtues (as we may term them) of the like strain. Which I should no sooner have made an end of, and shew'd you wherein consist the life and the death of a Vegetable; but presently, I should have in my view the reparation of



a decaying life, and the reproduction of a faded one: and so ingulf my self in the mysterious contemplation of the resurrection of dead and dissipated bodies; and how they may continue the same individuation, and be again the same identical body, after so many strange changes, and putting on so many different habits and shapes, as we daily see in the course of nature. To aim at performing all this now would be as fond a thought, as to put to Sea in a pair of Oars; with design to circle the whole Earth, and Visit both the Poles. Yet since on Mr. Surveyours motion to you, (upon occasion of what was, just now, so ingeniously deliver'd by our acute, learned, and judicious Associate Dr. Goddard, about the growing of Trees) you have thought good to command me to entertain you with my reflections upon this subject; I will, in obedience therto, give you such hints as may stir up others, by following them to make a compleat and polished piece, of that wherof I shall set before you only a rough draught: yet it shall be composed of such natural and assured strokes as may perswade you that there is no insuperable difficulty, nor inscrutable darkness, in all this admired progress.

But, let us look on it step by step; and consider at every joint or change, what new shape ought in reason appear next; and what new product is likely from time to time to arise out of the immediately preceding composition, so tempered, so qualified, and so accompanied with all its Concomitant accidents; and we shall presently conclude, that it would have been impossible any other thing imaginable should have resulted out of these principles and circumstances, than what hath been thus born out of natures fertile womb: And, be the seed never so remote from any appearing affinity with the Plant or Tree that at last grows out of it; yet, by this heedful survey, it will be evident to us, that, as long as water performs the action of wetting, Fire that of burning the Earth that of constipating and giving consistence to fluid bodies, and the Air that of mellowing and ripening what is exposed to his embraces; in a word, that as long as Nature proceeds in her regular course to perform these familiar actions which we are daily witnesses of, and which we find no difficulty to understand; so long (I say) it is impossible that any other thing in the World should grow (for example) out of a little shrunk

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Akehorn, then a spread vast Oak; or out of a single Bean, than that tall, green, tender Plant, so furnished with stalk, leaves, flowers, buds, seeds, (all in their several seasons) which appears so differing from that dry, hard, Grain first thrown into the Earth.

Let us date the beginning of our observation from thence. This dry shrunk compacted substance, being buried slightly in the moist ground, at a season when the approaching Sun (the great *Archens* and fire of nature) begins to dilate and sublime up to the superficies of the Earth, that volatile and balsamick Salt, which his remoteness during the winter had suffer'd to be shrunk up together and condensed and sunk deeper towards the Center; must of necessity receive into its substance that saline humidity, which environs it, is contiguous to it, and on all hands presses upon it. The immediate effect of this humecting the Bean or Akehorn must necessarily be, that it swells and grows bigger: for the substance of the water getting into the very substance of the grain that lies soaking in it; those two substances cannot choose but take up a larger room than formerly did belong to only one of them single. And from thence it will follow, that the skin which wraps up and contains the substance of the Bean, must needs crack and tear; to afford way and liberty to the dilatation of the swelled body: which having thus obtain'd room for it self to perform such actions as, in those circumstances are natural, and necessary to it (whereas before it was shut up and fetter'd in a cold, dry, and hard outside) it follows presently its own swing; and in that little natural body, we may read the fate which hangs over Political ones, when the inferiour members, that should study nothing but obedience, have gotten the power into their hands: for, then every one of them following their impetuous inclinations, the whole is brought into confusion; and that is destroyed which every one, in their tumultuary way, aim'd to gain the Mastery of; unless a superiour Architect, as in the present case of our bleeding Nation; *ever so missus succurrere seclo*, come to draw light and order, out of that darkness and confusion. It will happen then to this swollen Bean having now broken prison, that its fiery parts will work to gain dominion of the watry ones; and they calling the cold and dry ones to their several aids, will  
make



make a violent agitation through the whole mass; working and kneading the one into the other. This intestine motion; will cause a greater dilatation of the body so in combustion; than the first humecting of it did. For, the natural action of fire being to stream out from its Center on all hands in a continued flood of extremely rarified atoms; and they carrying along with them as continued a sequel of moist and viscous ones; it will necessarily follow, that they must have a larger field, than originally they had, to play their game in. Thus far of this work belongs to Fermentation: Which if it grow so violent that the fiery and spiritual parts get quite loose from the viscous ones; then, that which follows is a total Putrefaction, Dissolution, and Destruction of the compound: But, if to be kept within its due limits; then the body, in which it was wrought, is raised to a nobler pitch, and the Ethereal spirits of it are actuated, and put in possession of their native virtue; and the feculent, insipid, earthy ones are cast out from having any Society with them. But you do not expect from me (*my honoured Hearers,*) that I should discuss the Doctrine of Fermentation, to the utmost scope and extent of it: which, as it is one of the noblest and excellentest works of nature, and indeed the key to enter into the knowledge of all the actions and changes that are wrought under the Sun; so it requires a particular treatise entirely to it self, and will take up a whole man to draw a complete Map of its Empire. He will find that there is no disease in mans body, but springs from Fermentation; which, when it grows so violent and unruly, that the fermented humours can no longer be contain'd within their oppressed vessels, or is continued so long, that the spirits fly quite away, and thereby deliver over the remaining Mass to Putrefaction and Rottenness; Death, which is an essential dissolution of the whole compound, must necessarily follow. He will find, that the cures of all diseases proceed, from sometimes raising Fermentation to a due pitch, that it may cast off what is hurtful to the whole compound; and otherwhiles precipitating it, so that all the tumultuary motions of it may be composed, and a perfect calm may be induced in place of it. And lastly, (not to trouble you with too many particulars, arising out of a digression,) he will find, that when ever Nature intends the betterment of any body, she begins with



with dissolving and fermenting it in its due liquor : that so each essential part may be sever'd from his fellow, and refined to a nobler state, than it enjoy'd before; and then joyn'd again in a much perfecter society with his equally-ennobled companions, after the incorrigible faeces are expell'd from their harmony and union. Thus plain Clay, with Water from Heaven, may be brought to a Christaline purity and permanence; and Gold, to one of those Gems, which, in the *Apocalyps* we are told, serve for the Pavement of the heavenly *Jerusalem*. Find but a *menstruum* of its own nature, in which it may be radically dissolv'd and fermented; and the rest of the work will be easie. But, to make our Bean grow, we need not so great curiosity; and yet give me leave to say, the linear way of the one is not more plain and easie, than that of the other, to him that knows them. But be this how it will: As to the Bean, although the swelling and bursting forth of the fiery and viscous parts of it will be towards all sides; according to the nature of fire, which streams out from the center every way to the circumference; yet it will be most efficacious upwards toward the air; because it meets with less resistance that way, than any other. For, downwards, the Earth lies more compacted, than it doth over the grain; it having been stir'd and broken, to make the Mould loose and porous: and besides, there is a great quantity of it, which, the further you go downwards, grows the more difficultly penetrable; whereas, from the grain to the superficies of the Earth, and to the free Air, the journey is very small, and no obstacles in the way, by reason of the Sun, Air, Dew, and Rain, do still work upon it, to make it light and spongy. Upwards then, and towards the air, must be the speediest and the greatest concourse of these hot and viscous streams: which, coming into the cold air, and being invaded by it on every hand, contract themselves into such a figure, as is fittest to resist the assaults of such an enemy; which is the circular one. For, (to speak physically) the ambient air pressing these streams on all sides, reduces them into the narrowest room possible to serve them: and, the circular figure being the most capacious of all others whatever, the cold air condenses them into it; that so most matter may be con-

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tained



tained in least space. In the mean time, the streams out of the cracked skin of the Bean downwards and sideways are not altogether inefficacious; though not so vigorous, as those that ascend upwards towards the air. There will be this difference, between the ascending and the descending or spreading parts, which flow out of the fermenting mass: that the first will be hot, moist, airy; and consequently green and tender ones: the others will be more dry, cold, earthy, and therefore rough, hard, and white; whose hardness and roughness will also be encreased by the Earths pressing upon it. Thus, then, the Root is formed: which drawing continually new juice to it from the moist Earth that environs it, and abounding with heat that still digests and sublimes up the moisture it sucks in; and the outward agents (that is the Sun and Air) performing also their parts: it follows, that new digested and spiritual juice is continually sublimed up into that round, green, tender part, which was sprung up out of the Earth into the Air; and that now we may call the stalk. Thus, both the innate and the external heat concur to enlarge this Plant; by filling both the Root and the Stalk of it with continual new moisture: wherof the one, being exposed to Sun and Wind, must needs grow rough and hard on the out-side, to defend from outward injuries of weather the inner-part, that remains tender and juicy, and would else be soon nipped in its ascending; and the other thrusts down continually hard parts deeper into the Earth, wherby it remains firm and able to resist the agitations of the wind, without being easily eradicated. Now it fares with the Plant, as with a kindled fire of wood; the more fuel is apply'd to feed it, the more grows the heat: so here, the daily and hourly accreving of new balsamick juice encreases the heat that is within the Plant; and consequently there is continually more and more juice sent upwards. Thus the Stalk grows higher. But, the further this ascending juice goes from the main Center of it that sublimed it up, the weaker and fainter it becomes, and the less able to resist the invasions of the cold ambient Air. So that, when it can creep up no higher, it settles there. Yet, continually, the innate heat sublimes up more  
and



and more juice : which not being able to pierce the skin that it meets with at its journeys end, it swells there into a Button, that grows continually bigger and bigger ; till at length the skin, that enwraps this sublimed and daily more digested juice, not being able any longer to contain the quantity and activity of it, breaks : and, from that cloven button or knot, new juice ascends, in the same manner and progress as before ; till, at a just distance, proportioned to the causes that produce it, a new knot is made ; and so, from one to another, every one less than the other : till at length there wants juice to drive the Plant any higher, and withall, the subliming heat grows fainter at so great a distance, and the Sun begins to grow less active upon it ; and, in a word, the whole œconomy of Nature conspires to set here a period to the extension of the Plant. Some Plants use to shoot only upwards : but in others, when the button is forced asunder by the ascending juice, that juice pushes out, as well to the sides as upwards ; and so a Branch is made, breaking out of the main stock. And it happens that there break out so many such Branches, as there are concurrent circumstances and accidents (such as we have here mentioned) to form them. But, when Nature hath set a period to the extent of her growing Plant, and is, as it were, weary of teeming any longer with such strong and nervous issues (that is to say, that the innate heat, the juice, and the Sun, begin to flag in their operations (for the reasons I have touched) : yet, never consenting to be idle and sit still, she betakes her self to works of less robustuous force ; and, refining still more and more, by gentle sublimations and depurations, the juice she hath brought up thus high, she continually makes it cast off the grosser parts, (which stick by the way ; as not being nimble enough to rise higher, nor subtil enough to pass through those freight chanel's which afford the refined spirits an easie course.) Yet are not these gross parts without employment, (I call them gross, only in respect of the purer spirit ; for otherwise, they are much more subtil and concocted, than those which remain in the stalk, trunk, or bark of the Plant). 'Tis true, they are not able to go along with the



æthereal spirit, which takes a higher flight; as you shall by and by hear: but they are continually encreased with hourly supplies of like gross or subtil parts; as you shall please to call them (for indeed, they are either, or both; subtil in respect of the grosser juice they are sublimed from, and that remains below in the body and trunk of the Plant; and gross, in respect of the ardent spirit and balsamick oil that is rectified from them). This perpetual new concourse of fresh matter to the Branches, which grow too full to contain it, is the cause of their cleaving in several places, where this juice pushes to get out. If it be very viscous and unctuous, and have been long concocted by the Sun without, and the innate heat within, before it breaks out; it shews it self in a gummy substance; that retains in it the nature of the whole Plant; as I shall hereafter convince experimentally, besides the evidence of the reason that concludes it must be so. But, if nothing have intervened to hinder or alter the ordinary course, then, this, more-watry-than-unctuous juice, making its way into the air through the tender skin of the branch or stalk, suffers all the like actions upon it as were formerly wrought upon the first juice that broke out of the original Bean or Akekorne: and so it begins to be formed there into a new Plant; of a shape, figure, and nature proportioned to the great one it shoots from. First, a thrird shoots out in a direct line, that we may fitly call the Stalk of this new little Plant; and at a distance, adequate to the heat that sublimes and pushes it out, and to the cold air that nips and shrinks it into a button, the first knot is formed in this little stalk: from whence new streams or thrirds are push'd out, both forwards and side-ways: as we have formerly explicated, in the first gross forming of the bulky Plant. These thrirds, that are thus spun out every way one from another, grow to be so near one another, that the streams which necessarily must accompany them (for, wherever heat drives out store of moisture, there cannot choose but be an atmosphere of emanations environing and besieging, as I may say, the main stream) easily mingle with one another: and, being of a viscous and adhesive nature (as all such moist and hot emanations must necessarily be) they fill up with their glewy matter the intervals between the



the main thrids. Which we may compare, not improperly, to a curious Work-womans filling up of Flanders-lace with fine thrid: in the doing wherof, she interweavs so cunningly the thrid she brings with those standards of thrids (as I may call them) that she already finds in her work before her; that, while she fills up all the vacuities, she still leaves those main thrids so discernable, that your eye can, after all, distinguish the work of the Patern, as clearly as if here had been nothing done to it. So, in this filling up the interstices of the new little Plant, you see plainly all the sinews and thrids of it; after the viscons steams which hang about them are plaited and wrought into a continue substance: that is, jagged or dentilated, according as the main thrids are pushed forth to be longer or shorter; which depends on the heat that carries the viscons parts with it. And thus the Leaf, a second Plant, is formed out of the branches and twigs of the first; retaining the shape, figure, and other qualities of it. Now, all the while this is doing with the grosser parts, which the rectified spirit casts off, the heat, which rectifies and sublimes it, pushes forth this elaborate juice into more tender substances, more abounding with vigour and spirits: Especially at the extremity of the branches; where the solidest part of the abounding humor grows (as before in the rising of it in the stalk of the Bean, or in the body of the Oak) into a button; but the more volatile and less substantial part of this highly rectified juice, or rather new spirit, is spread round about it in thin sheets: which, being full of the aerial and sulphureous parts of this rectified spirit (which here, by the iterated rectifications, becomes like an ardent water) delight the eyes with variety of colours, and the nose with pleasantness of smell (for Sulphur is the universal great painter and perfumer of the world); but, being of so volatile a nature as the much refining and often rectifying it, reduces it to be of, these flowers are not of long durance, but soon fade and fall away, as also their beautiful and odorous spirits exhale from their dead and withered habitations. But, all this while that this æthereal or wild spirit recreates it self thus in these transitory flowers, a more solid and substantial one, and that endures a more vigorous concoction, (as in distillations, where the



balsamick oil comes last) fills and swells the button, that hath by this time lost his gay companions, the faded flowers. And, as it grows bigger, it grows also softer and tenderer in the whole bulk of it. For, the Sun still draws to the outside the subtilest, the most juicy, and the most aerial parts of it; and therefore all that substance must be soft, mellow, and tender: only the extremity and last superficies of the outside must needs have contracted some hardness and roughness, from the coldness of the air and the biting sharpness of the wind; which makes the skin of a Pear, or Apple, or Walnut, rougher and harder, than the pulpy tender substance next adjoining to it. Yet, out of the course here set down, it will follow, that, towards the center of this tender substance, there must needs be some hard, dry, and rough matter. For, seeing that the Sun from without attracts to the superficies of the fruit the most spiritual and aery parts of the ascending juice; and, on the other side, the innate heat from within drives it out, and extends it from the Center to the superficies: Tis impossible but that, about the middle, from whence all this attraction and expulsion of tender juice is made, there must remain store of earthy parts deprived of moisture, and baked into a hard nucleous substance, containing much of fire, though little of air and water in it. For, it is the nature of fire, to incorporate it self with the substance it bakes and calcines: as you have sensible experience in the calcining of Antimony by a burning-glass; when, the calcined body encreases much in weight, though at the same time the Fire drives away a wonderful quantity of the moist and volatile parts of the smoaking mass. This button, thus dilated and brought to this pass, we call the fruit of the Plant: whose harder part encloses oftentimes another, not so hard as dry. And the reason of this is, that the outside or superficies of this earthy substance is become so exceeding hard, by the concurring causes which make it so, that no moisture (or at least, no considerable quantity) can soak through it: and then, the action of heat being continually prevalent upon what hath no supply of moisture, all the substance which is enclosed within that hard superficies must needs grow dryer and dryer; till at length it becomes like



like fine subtile dust compacted together which shews it self to be so, as soon as it is bruised out of the husk that contains it; as we daily see in Corn ground at a Mill; and it is as evident in the kernels or little seeds of Pears, Apples, Oranges, Almonds, and the like; if you work in like manner upon them, after they are thoroughly dried. Yet this dryness is not to such a degree, as when, in Calcination, by violence of fire, the moist and volatile Essential parts of a body are entirely driven away. For here, the agents being gentle and natural ones, and the ambient moisture and cold defending the seed from excess of drought and heat; and the whole course of this progress tending rather to Fixation than to Calcination: it happens that, in every parcel of this compacted dust, the nature of the whole Plant resides perfectly and entirely; as it were contracted into a small quantity. For, the juice which was first in the button, (that is now become the Fruit), and had passed from the root through the manifold varieties of the divers parts of the Plant; and had suffered much concoction and depuration, partly from the Sun and partly from the inward heat imprisoned in that harder stony part about the middle of the fruit: this juice is, by these passages, strainings, concoctions, and sublimations, become at length to be of the nature of a tincture extracted out of the whole plant; and is at last dried up into a kind of Magistery, full of Fire and of Salt. This is that which we call the Seed; which, being buried in the Earth, and soak'd with fitting humidity, (in such sort as we have here at large declared), sets on foot this work a-new, and repeats over again all that we have hitherto observ'd in this long progress. In which the steadiness of the Supreme Architects hand, that steers and governs it, is never enough to be admired: who hath set on foot such an exact concurrence of divers and most distinct causes, to conspire all to one and the same end; that still, in general, Nature arrives to her destined period, without being frustrated of the scope she levels at. Whereas, a man that should stay his consideration at every joint of this long career, and should reflect how easily some little circumstance, in so vast a multiplicity of them, might be turn'd awry (as when an atome of dust falls among the wheels of a nice clock); or rather, how difficult it must needs be for one single governour to keep them



all in their due æquilibrium: such a consideration, I say, might be apt to conclude, that not one of ten thousand should prove, as it doth. And, he that should look barely upon the two extreme terms, the beginning and the completing of a Plant, might think there were a perpetual miracle in the production of Vegetables; and might be excused for having recourse to a *vis formatrix*, and such other insignificant terms. But, another, that considers the whole course of nature set on foot by God Almighty for this admirable work; and fixes his foot at every particular joint, not stirring it from thence, till he have fully examin'd and discuss'd what must necessarily follow out of such or such matter, in such or such circumstances, so and so temper'd, and so and so wrought upon; will evidently discern, that it is throughout impossible any thing should happen in it otherwise, than just what, and how it doth. And, 'tis want of consideration and judgment, which makes men fly to occult and imaginary qualities; to shroud their ignorance under inconceivable terms: Whereas Nature in her self is perviewous and open to humane discovery; if a due course be taken to dissect and survey her.

Out of what I have discoursed of the progress of Nature, in the growth of Trees and all manner of Plants, it will be easie to satifie such Questions and Doubts concerning them, as, at the first sight, may seem full of difficulty. As, for example, Why the grain of a tree should affect such or such a situation and tendence in respect of the great Universe: which some shallow Clerks will have pass among the recondite Mysteries of Nature, shut up to mortal eyes farther, than to see a secret instinct and sympathy between plants and the polar Star. All which is nothing but this, that the tender Plant, at its first pushing forth, being check'd by the ambient air, and warm'd by the enlivening Sun, is most streighten'd by the cold Earthy atoms which are drawn by the Sun from the Poles to the Equator: For, there being a constant perpetual course of them that way (as I have shew'd in my Book of Bodies), such things as lie in their Channel must necessarily be affected with their continually-repeated strokes: And that side of them, which is exposed to their

immediate



mediate blows, must be most sensible of them. On the other side, the Sun, with his warm and moist Regiment of atoms, embracing the opposite part of the Plant, must needs work a contrary effect to the other. And thus you see a plain and evident reason, why one side of the Plant cannot fail of being close, hard, and heavy, in respect of the other; and tending to some acuteness, rather than perfectly round: The other will be spongy, tender, light, and dilated; having its Figure enlarged beyond roundness. Now, this first impression serving for a Rule to what afterwards shall follow, and the outward case of the Plant being as it were a mould to cast the succeeding juice in: it will follow that, at every Year, or Month, or Week, (according to the nature of the Plant) when new juice is sublimed up into the hardened case, and this new juice distends the case to make room for it self; it will take such ply and Figure, acuminated on the one side, and obtuse on the other, as the case already hath, and is apt to give. This will be repeated every year in Trees, and in such Plants as count their livelihood by years. And by these circles of the Grain, you shall not only know how the Tree grew when it was planted, in regard of North and South; but also how old it is. And if you will transplant it to another place, you must have a care to set it in the same Situation it first grew in: for otherwise, exposing the tender, mellow, South-side of the Tree, to the sharp hard wedges of the Northern air; they will so cleave and batter it, that, in a little while, it will exhale its spirits and die. And the same reason obliges also, that every piece of wood, even after it is dead and hewed out, be Magnetical, and have respective Poles to the Universe. For, the constant course of one sort of atoms, running one way through it; must needs have bored and wrought such figured Channels, as are proportionate to admit such figured and qualified atoms as they are, and to reject and repell others of a different nature and formation: In such sort as I have at large discoursed, in my above-mentioned Treatise; where I set down the wole Doctrine of the Load-stone and its *Phænomena*, and give the reasons of them. From the same cause it will follow, that, if you turn a piece of wood into a Sphere, or Cylinder, or other Regular Figure,



Figure, and put it into the water; one precise side of it will always sink, and the other swim out of the water. And, out of what I have said, the reason is evident, why, after much drought in a hot Summer, Trees and Plants will languish, wither, and look as though they were dead; till some Rain fall to cure their sickness: and then, all Vegetables take a new green habit; as though a second Spring were come to animate them. All which is nothing else, but that the long continued scorching Beams of the Sun had exhausted all Humidity from the Plants: And then, fresh moisture coming to the Roots, it is sublimed thence into the stalks; and makes a new Germination and Leavs, in the manner I have declared.

Many other such consequences would irrefragably follow, out of the premised principles; which would be too long to pursue farther here: 'Tis enough to have given the hint of thus much; after which, any ordinary reflection will retrieve innumerable other conclusions. But, I think it will not appear tedious to you, that I touch a little upon what course may repair a decaying Plant; or exceedingly augment the virtue of a prosperous one: since, not only the Philosophy of it is pleasing and considerable; but also the practice of it may be profitable to the Common-wealth, and useful (with due Analogy) even to humane Bodies. The Sickness, and at last, the Death of a Plant, in its natural course, proceeds from want of that balsamick Saline juice; which I have said, makes it Swell, Germinate, and Augment it self. This want may proceed either from a Destitution of it in the place where the Plant grows; as when it is in a barren soil or bad air: or, from a defect in the Plant it self, that hath not vigour sufficient to attract it, though it be within the sphere of it; as, when the Root is become so hard, obstructed, and cold, as that it hath lost its Vegetative Functions. Now, both these may be remedy'd, in a great measure, by one and the same Physick. It is not every humidity that is of a prolifick nature. If water have not her fire in her, she will avail little to make Plants fructifie. The watering of soil with cold hungry Springs doth little good: Whereas, muddy Saline waters, brought to overflow a piece of ground, enrich it much.

Gentle



Gentle showers, especially in the *Equinox* Seasons, are very fruitful : But, above all, well digested Dew makes all Plants luxuriate and prosper most. Now, what may it be that endues these Liquors with such prolifick virtue? The meer water, which is common to them all, cannot be it : There must be something else enclosed within it, to which the water serves but for a Vehicle. Examin it by the Spagyrick Art ; and you will find it is nothing else but a nitrous Salt, which is dilated in the water. It is this Salt which gives fecundity to all things : And from this Salt (rightly understood), not only all Vegetables, but also all Minerals draw their origine.

Here, it were not from the purpose to put you in mind, how the Ancient *Poets* (who comprised their deepest wisdom in familiar Fables) tell us long stories of their Salt-begotten Goddess ; and adumbrate their best knowledge of Nature under Saline veils. But, I should be too prolix, if I hunted too far every Chace that rises before me in this copious Forest. I will come back to my own and others plain experiences. By the help of plain *Salt-peter*, dilated in water and mingled with some other fit Earthy substance, that may familiarize it a little with the corn into which I endeavour'd to introduce it ; I have made the barrenest ground far out-go the richest, in giving a prodigioussly plentiful Harvest. I have seen Hemp-seed soaked in this Liquor, that hath, in the due time, made such Plants arise, as, for the tallness and hardness of them, seem'd rather to be Coppice Wood of fourteen yeas growth at least, than plain Hemp. The Fathers of the Christian Doctrine at *Paris*, still keep by them for a Monument (and indeed it is an admirable one) a Plant of Barley, consisting of 249 stalks, springing from one Root or Grain of Barley ; in which they counted above 18000. Grains or seeds of Barley. But do you think that it is barely the Salt-peter, imbibed into the Seed or Root, which causeth this Fertility ? no ; that would be soon exhausted, and could not furnish matter to so vast a progeny. The Salt-peter, there is like a Magnes which attracts a like Salt that Fecundates the Air, and gave cause to the Cosmopolite to say, *there is in the Air a hidden food of Life*. Such Airs, as are most impregnated with this benign fire, are healthful to live in : Others, which abound with



with Earthy exhalations or Marishy vapours, and have little balsamick Salt in them, are as unsound. This is the food of the Lungs, and the nourishment of the Spirits. *Cornelius Drebel*, having contracted a great quantity of this into a narrow room, could recreate and revive his languishing guests, in his straight house under water; when they had fed upon all the balsome that was in the air shut up with them: by opening a Phiol, that dilated it self with fresh Spirits into that stale depredated and exhausted Air. This spirit, then, that is in the Air is drawn (as it were by a Loadstone) by the Saline Liquor which is imbibed into the Seed which is full of it. My own eyes are witnesses of the wonderful corporifying of it: I have seen it grow in a strange proportion. In a *Villa at Rimo*, I sow'd some Barley thus prepared: and, what with the Dew, what with the Air, and what with the Sun, I should in the mornings, by then the Sun-beams had dry'd up the superfluous moisture see sproutings up of pure Salt-peter of a prodigious height, all about and over the Seeds, that lay slightly cover'd with the loose mould. They would be above an inch, nay two inches long, of the purest Christaline Salt-peter that could be seen. And, it is upon this principle that the Pope in his State, and the old Duke of *Bavaria* in his, did first make and then nourish Mines of Salt-peter; whose Roots and Quarries are quite different from other Minerals: For, they are under-foot in the Earth, and these over our heads, in the Air. This is the Earth flying over mens heads, which a late subtil Philosopher prescribes to be taken for his great work. Now, in this Salt are enclosed the Seminary virtues of all things. For, what is it, but a pure extract, drawn by the Sun-beams from all the bodies that he darts his Rays on; and sublimed up to such a height of place, as leavs all feculence behind it: and is there in that exalted Region of the Limbeck, baked and incorporated with those very beams themselves, which refined this extract out of its drossie Oar? Therefore, I wonder not to see any sort of Herb grow upon the highest Towers, where 'tis certain no man ever came to sow that Plant. And, the Loadstone or Magnes, of a like substance, (though nothing near so pure) that is in the Earth, the creeping Toad there, sucks and pulls down this flying Dragon to it; and both of them



them become one body. And thus you see plainly and familiarly explicated the great Aphorism of the Smaragdine Table; that *What is above is like what is below. The Sun is the father, the Moon is the Mother; the Earth is the Matrix, wherein this product is hatched; and the air conveyed it hither.* This Universal Spirit, then, being homogeneous to all things, and in effect the Spirit of Life, not onely to Plants, but to Animals also: were it not worth the labour to render it as useful to mens bodies, as to the reparations of Plants? *Albertus Magnus* purchased the reputation of a Magician; for making all Sorts of Fruit grow plentifully and perfectly, in the depth of a hard winter in *Germany*, by means of this æthereal balsome. If it were made proportionable to mens bodies, no doubt it would work a like effect upon them. Gold is of the same Nature as this æthereal Spirit; or rather, it is nothing but it, first corporify'd in a pure place, and then baked to a perfect Fixation, *Raymund Lully*, (in his excellent Treatise, *De intentione Operantium*) describes admirably well the Genealogy of it. If then this perfect body (I mean Gold) could be render'd familiar and digestible to ours, no doubt but it would prove a kind of Tree of Life to us. It is of it self too firmly compos'd, for any Agent upon Earth to dissolve it. But peradventure the Mother that bore it, may re-incrudate and reduce it back into its first volatile principles.

Enough, if not too much, is said of these Curiosities, by way of digression, and to entertain you (Noble Auditors) with pleasing variety. Let us come back to our Plant, and enquire if it be not possible to render it perpetual; or rather to convert it into a permanent substance and state, no longer subject to the Vicissitudes of time and outward Agents, that destroy all things: So to bring it to a kind of glorified body, such as we hope ours will be after the Resurrection. *Quercetanus*, the famous Physician of King *Henry* the fourth tells us a wonderful Story, of a *Polonian* Doctor, that shewed him a dozen glasses, *Hermetically* Sealed; in each of which was a different Plant: for example, a Rose in one, a Tulip in another, a Clove-Gilly-flower in a third; and so of the rest. When he offered these Glasses to your first view, you saw nothing in them but a heap of Ashes in the bottome. As soon as he



he held some gentle heat under any of them, presently there arose, out of the Ashes, the Idea of a Flower and the stalk belonging to those Ashes) and it would shoot up and spread abroad, to the due height and just demensions of such a Flower; and had perfect Colour, Shape, Magnitude, and all other accidents, as if it were really that very flower. But when ever you drew the heat from it; as the Glass and enclosed air and matter within it grew too cool by degrees, so would this flower sink down by little and little: till at length it would bury it self in its bed of Ashes. And thus it would do as often as you exposed it to moderate heat, or withdrew it from it. I confess it would be no small delight to me to see this experiment, with all the circumstances that *Quercetan* sets down. *Athanasius Kircherus*, at *Rome*, assured me he had done it; and gave me the process of it. But, no industry of mine could effect it. Another I did by instructions from the former Author; and I found it exactly true, as he recounts it. 'Tis worth your knowing. I calcin'd a good quantity of Nettles (Roots, Stalks, Leavs, Flowers,) : in a word, the whole Plant. He produces the example in this very Plant; and I would not vary in the least circumstance from what he taught. With fair water I made a Lye of these Ashes; which I filtred from the insipid Earth. This Lye was exposed by me, in the due season, to have the Frost congeal it. I perform'd the whole work in this very house, where I have now the honour to discourse to you. I calcined them in the fair and large Laboratory, that I had erected under the Lodgings of the Divinity-Reader: And I exposed the Lye to congeal in the window of my Library, among my Lodgings at the end of your great Gallery. *Hans Hunneades* the *Hungarian*, was my Operator. And it is most true, that, when the water was congeal'd into ice, there appeared to be abundance of Nettles frozen in the ice. They had not the colour of Nettles: No greenness accompanied them: they were white: But otherwise it is impossible for any Painter to delineate a throng of Nettles more exactly, than they were design'd in the water. As soon as the water was melted, all these Ideal shapes vanish'd: but as soon as it was congeal'd again, they presently appeared afresh. And this game I had several times with them, and brought Doctor *Majerus* to see it: who,



I remember, was as much delighted with it, as my self. What could be the reason of this *Phaenomen*? There is no doubt but that a main part of the Essential Substance of a Plant is contain'd in his fixed Salt. This will admit no change into another nature; but alwayes be full of the qualities and virtues of the Plant it is derived from: but for want of the volatile Armoniacal and Sulphureal parts, it is deprived of colour. If all the Essential parts could be preserv'd, in the severing and purifying of them; I see no reason but, at the re-union of them, the entire Plant might appear in its compleat perfection: so one could find a fit *medium* to dilate it in. Were not this a true *Palingenesis* of the original Plant? I doubt it would not be so: For speaking rigorously I cannot allow Plants to have life. They are not *se moventia*: they have not a principle of motion within them. It is the operation of outward Agents upon them that sets a foot all the dance we have above so heedfully observed, and which so near imitates the motions of life. And if it be not a Living thing, then it is all of it in perpetual Flux and Change; without having any part that enjoys a fixed and permanent Being, for the least moments space; and consequently there can be no resurrection of it after once it is destroyed, since it never was at any time a determinate *It*, or *Thing*. But, as Coals are made of wood by the action of Fire upon it; and Ashes again of them, and Glass of Ashes; each of them a quite different substance from what the precedent was: So, I conceive, that a new aereal body and thing is made out of the Plant, that furnish'd Matter, for this new substance; and whose substantial Form is totally destroyed, and a new one produced into the World; which is accompanied with many accidents, like many of those that belong'd to the precedent substance. I remember another pretty experiment, that Doctor *Davison* shew'd me in his Laboratory at *Paris*. He had been drawing the Oyl and Spirit of a certain kind of resinous Gum: And it so hapned, that the Glass, along which it rose; was all covered over on the inside with Portraitures of Fir-Trees (from whence that resin distilled) so exactly done, that no Painter in the world could have drawn their shapes more compleatly. The like hapned to me once, in distilling the Gum of Cherry-Trees. But none of these *Ideas* come so near to the real *Palingenesis*, as what I have



have done, more than once, upon *Cray-Fishes*. Wash them clean from any Earthiness; and boil them very thoroughly (at least two hours space) in sufficient quantity of fair water. Keep this decoction, and put the *Crevisses* into a Glass-Limbeck; and distill all the Liquor that will arise from them: which keep by it self. Then calcine the Fishes in a reverberatory Furnace; and extract their Salt, with your first decoction: which filter, and then evaporate the humidity. Upon the remaining Salt pour your distill'd Liquor; and set it in a moist place to putrifie: and, in a few days, you shall find little Animals moving there about the bigness of Milet Seeds. These you must feed with the blood of an Ox, till they be as big as pretty large buttons: then put them into a wooden pail of River-water and Ox-blood, changing the water and blood every third day; and so you may bring them on to what bigness you please.

All this leads me to speak something of the Resurrection of Humane Bodies. There we may find some firm and solid footing. Hitherto we have wander'd up and down in the Mazes of Fleeting matter, *que nunquam in eodem statu permanet*: and, with great truth, did *Job* apply that expression to the State of Men living in this World. But as soon as we shall have put off our frail Mortality, we shall be in a state of permanence and immutability. Not only while the Soul is separated from her Earthy Companion; but, when she shall be clothed again, that new flesh will partake the constancy of her glorious Mate. But why do I call it *new flesh*? I may be pardon'd for doing so, when I consider the new qualities and endowments it shall have put on: But, otherwise, in substance and reality, it is the same, the very same, that (for example) accompany'd me in this long and tedious Pilgrimage upon Earth. How is this? If a Canibal should feed upon my body, and convert it into the substance of his; can both of us rise again with the same bodys we enjoy'd here? Yes, without doubt we may. And, I conceive, the taking away of this difficulty, which hath so highly perplexed even the best Christians, will be so welcome a performance to them who yet have not met with it; that, for its sake, you will pardon the tediousness and courseness of all I have hitherto said. And, with that, I will  
cease



cease further troubling you. But, let us first rightly understand one another. I do not undertake to shew here, how this great Work is wrought : much less to determine, that it will follow out of the force of Nature, after the *Great Day's Conflagration* hath calcined the whole Mass of Matter into a formless heap of Ashes ; so disposing it, by excluding and destroying all particular Forms, to admit the action of subsistent ones upon it. But, my undertaking is, to convince that there is no impossibility nor contradiction in nature, against this great and amazing Mystery. If there were contradiction in it, it could not be true : it were not the subject of a Miracle. But, if I prove that there is no repugnance against the feasibility of it ; I am confident I shall not miss of hearty thanks from those sincere Believers, who have nothing to shake the firmness of their Faith, but the suspected impossibility of the Mystery. Thus then, I shall begin with enquiring, what it is that makes a body continue still the *same*. All bodies are composed of matter and form. In saying of which, I do not mean, that there are two distinct Entities, which, being put together like meal and water, concur jointly to compose a body, as they make bread : But, they are Notions, grounded upon a real Foundation in the Object whence they arise. In the Object there is that, which corresponds adequately to the Notions we frame of these two Principles. We see that this which is now Coal, was lately Wood. Somewhat must be common to both these distinct Substances ; else we must allow the first to have been annihilated by the change, and that nothing remains of it after the action of fire : and consequently, that the second is absolutely created ; without any præexistent matter to serve for a Basis to this production. This obliges us to have recourse to somewhat that is common to both these things. This, that is thus common to both, *is*, of it self, neither the one nor the other ; But is that, which *may be* either the one or the other. So that, truly, it is not this nor that, nor any determinate thing : But it is a capacity to be this or that, or any thing whatever. And this capacity is called, in the Schools, Matter. Now, that which fills and actuates this capacity, and makes it be a determinate thing, is that which they call the Form. So that, the Form is the compleating and perfecting of a Body, and makes



it to be this or that, and fixes it in the state of *Being* : whereas the Matter, abstracted from the Form, hath no determinate being, no individuation, is, in effect and actually, nothing; but hath, or rather is, a capacity to be any thing. It must not then be on the side of Matter, that we must look for the individuation and Identification of our Bodies, after the Resurrection. All Matter is indifferent to every Form. There is no this or that in matter; otherwise than as the Form engrosses it to it self, and thereby makes it this or that. And consequently, as long as the Form remains the same, the Thing is the same and the Matter is the same. Were it not for this, how could any body under Heaven remain the same; even but for a short Moments space? All sublunary things are in a perpetual *Flux*. The contrast of the Elements among themselves within every body, and other bodies without it, working also perpetually upon it, are causes that, out of every body, there are continual emanations; and that there are continual supplies advenient to it. Every thing is like a River, that is in a perpetual course: which, though we account it the same River to day, as it was yesterday; yet in truth there is not one drop of water in it to day, that was in it yesterday. But, because it is fill'd out of the same common Magazine of in-itself-undistinguish'd water, which fill'd it yesterday and a hundred years ago; and that it is comprised in the same Channel: 'tis still esteem'd to be the same River. I remember to have seen, in the King of *France's* Garden at *St. Germain*, very curious Grotto's; whereof one was adorned with a cast of water, so contrived, that, as fast as the water fell down into the reserve or Basin at the bottom of the Pipe that cast it up with force a pretty height, the water was still convey'd up again into that casting Pipe; and so made a kind of perpetual motion. The Gardener, to entertain his Spectators, used to put sundry hollow instruments, of different shapes and Figures, upon the mouth of the Pipe that cast up the water: so that the coarcted stream would spread it self abroad, as soon as the instruments afforded it liberty, sometimes like a Bell, sometimes like a Crown, otherwhiles like a Flower-de-Luce, and the like; according to the Form of the Instrument that comprised and govern'd the course of the water. There were



were several Bells and several Crowns, with peculiar differences belonging to them; and so of the rest of the Machines. If now, after I had seen two or three differently appearing Bells or Crowns, I should desire to see again that Bell or that Crown, which the Gardener shew'd me first; and he should put on that Machine which he did put on the first time: should I not have reason to say, it were the same Bell or Crown I saw first? The water that furnishes matter to all these varieties and games, is still the same. As long as it is in its great bulk, there is no this or that part of it; all of it is one Mass, that hath no this or that distinguish'd any where in it: But if you take never so few drops of it in a particular vessel, that divides it from the rest; then, there is this glass-full (for example) distinct from the rest of the common Magazine. And so, while the first Engine or Pipe, to represent a Bell, is put on a second time; it denominates truly that Bell to be the same it was at first: and while it is in continual flux of new parts of water succeeding those which run down into the Basin, and that rise again to continue that figure; it is still the same Bell. Much more rigorously is it true, that my eyes, my ears, my whole body, now after near 60. years durance in Nature, are the same, the very same, they were, when I lay a weak *Embryon* in my Mothers Womb. The continual flood of transpiration, and the continual supply of augmentation, nothing hinder the Identity of this Body of mine; as long as the Form, which makes it be what it is, remains still the same. If then the Form of Man, which is his Soul, remains the same after its separation from the Body, as it was while co-partner with the Body: what difficulty is there to allow her to have the same Body she had in this World, if she be built up again to a whole Man, out of the general Magazine of Matter; which furnish'd her with a Body before, and which hath no this or that belonging to it, otherwise than as some Form engrossing it, makes it be this or that Body? There is nothing more clear, nothing more evident, nothing more rigorously true.

F I N I S.







